THE PROBLEM OF BUSINESS FORECASTING

Papers presented at the Eighty-Fifth Annual Meeting of the American Statistical Association, Washington, D.C., December 27–29, 1923

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BOSTON AND NEW YORK
HOUGHTON MIFFLIN COMPANY
The Riverside Press Cambridge
1924

PREFATORY NOTE

HUMAN conduct is based largely upon forecast, and forecasts are based largely upon statistics. At first sight, this sweeping statement may seem far from the truth, so much of human conduct appears to have no rational basis whatever. Yet a little thought will show, first, that nearly everything men do in the present is done with the expectation that certain events will take place in the future; and, second, that the expectation itself grows out of events which are known or supposed to have taken place in the past. And that is precisely what we mean by rational conduct. It matters not what the question at issue may be. It may concern buying a radio set, choosing a career, insuring against accident, taking a train or planting a tree. In every case, the decision is made on the basis of expectations which, because of a number of past occurrences, appear to be reasonable. Even those events that sometimes seem to be prompted purely by emotion, such as getting married, are not exceptions to the rule. Among sane people, what we call irrational conduct does not differ from highly rational conduct in having no statistical basis. The difference lies in the adequacy of the statistics for the purpose at hand and in the way in which they are used. Men make many mistakes, to be sure. These mistakes, however, are seldom due to reckless disregard of the future. They are due mainly to one or both of two causes: first, the unreliability of the data; second, faulty reasoning. In short, forecasts based on statistics determine nearly everything that men do to-day because, throughout the centuries, only those men whose conduct

has been thus actuated have survived and reproduced their kind.

What is true of human conduct in general is true of conduct in business. When a man enters business, he enters a forecasting profession. He may forecast badly or well, but forecast he must. He may scorn business forecasters, but he cannot help being one. He may shun statistics, but he cannot help using them. Since business is essentially risk-taking with the expectation of profits, every enterpriser must run risks; and, as a risk-taker, he is necessarily a business forecaster. That is to say, his decision to take a risk is based on predictions concerning the degree of the risk and the reward for taking it. He must decide when to make loans, when to buy cotton, when to build a factory, what styles of shoes to manufacture, when to increase his output. In every case his decision to take one risk rather than another is influenced by his expectation concerning the future — the trend of interest rates, the price of cotton next week, building costs next April, the demand for tanned shoes next spring, the output of competitors next year. Indeed, any enterpriser could fill an entire volume with the decisions he is forced to make in the ordinary course of business, and every one of them would involve forecasting on a statistical basis.

Business men, therefore, may find this book of some value. Its central theme is the statistical basis for analyzing current economic conditions for the purpose of making forecasts of business activities. In the various chapters, specialists deal with such problems as those involved in predicting cotton crops, metal prices, corn-hog ratios, demand for lumber, freight-car loadings, foreign trade and automobile production. These problems and all the others discussed in this book are not academic: they are part and parcel of industry and trade. Business

men must deal with them; and, in dealing with them, they must make judgments concerning the future on some statistical basis or other. The only question is how to make the basis and the judgment as sound as possible. The contributors to this volume, however, do not undertake to tell precisely how to forecast: they discuss *the problem of business forecasting*. They offer their several chapters as parts of the work that must go steadily forward if statistics and methods of interpreting statistics are to become progressively more reliable. As this work goes on, year after year, they urge business men to use the findings of professional forecasters, but to use them with skepticism and caution, and always in the light of their own judgment and experience.

WILLIAM TRUFANT FOSTER
Editor of the Pollak Publications

NEWTON, MASSACHUSETTS
July 1, 1924

CONTENTS

LIST OF FIGURES

THE PROBLEM OF BUSINESS FORECASTING

CHAPTER I

THE PROBLEM OF BUSINESS FORECASTING[1]

BY WARREN M. PERSONS

THE general topic for discussion in this book is "the statistical basis for analyzing the current economic situation, with the object of making forecasts of business conditions in general and for the great groups of economic activities in the United States." This topic explicitly recognizes that statistics may be effectively utilized not merely to describe the past, but as a basis for estimating present and future tendencies. The point of view thus indicated is neither new nor revolutionary. When the Statistical Society of London was organized in 1834, five years before the American Statistical Association, the prospectus announced that its functions were to "procure, arrange, and publish facts calculated to illustrate the condition *and prospects* of society." The evaluation of "the prospects of society" was thus recognized in this early statement as a proper object of statistical research.

It was not by accident that the idea of utilizing statistics of the past condition of society for inferences concerning the future appeared in the prospectus of 1834. That it was expressed deliberately and with compre-

[1] Presidential Address at the Eighty-Fifth Annual Meeting of the American Statistical Association.

hension of its significance is indicated by an interesting and pertinent incident in the organization of the London Society, related by its former president, Sir Athelstone Baines. A Statistical Section of the British Association for the Advancement of Science had been organized in 1833, in which the studies were limited to "facts relating to communities of men which are capable of being expressed by numbers, and which promise, when sufficiently multiplied, to indicate general laws." "Several men of eminence on statistics," says Sir Athelstone, "chafed at being thus relegated to the position of 'hewers and drawers for political economy and philosophy'; so they joined in promoting the Statistical Society of London, now the Royal Statistical Society, with the view of providing therein a wider scope for their inquiries." [1] They considered it to be the function of *the statistician* to interpret and draw inferences from his statistics, and organized the Statistical Society for the purpose of furthering the development of that function.

It is my object to discuss some fundamental concepts of statistics. I shall consider, particularly, the logical significance of a statistical exhibit, the nature of statistical inference, and some of the important concepts involved in making forecasts of economic conditions on the basis of statistical analyses of limited periods in the past.

The necessity of the accumulation of statistics of the complex world of affairs in which we are immersed and the equal necessity of the development of special methods, different from those of the exact sciences, for summarizing these data have been admirably expressed by John T. Merz in his *History of European Thought in the Nineteenth Century*. "That which everywhere oppresses the practical man," he says, "is the great number of things and events

[1] *The History of Statistics*, edited by John Koren, p. 385.

which pass ceaselessly before him, and the flow of which he cannot arrest. What he requires is the grasp of large numbers. The successful scientific explorer has always been the man who could single out some special thing for minute and detailed investigation, who could retire with one definite object, with one fixed problem into his study or laboratory and there fathom and unravel its intricacies, rising by induction or divination to some rapid generalization which allowed him to establish what is termed a law or general aspect from which he could view the whole or a large part of nature. The scientific genius can 'stay the moment fleeting.' . . . The practical man cannot do this; he is always and everywhere met by the crowd of facts; by the relentlessly hurrying stream of events. What he requires is grasp of numbers, leaving to the professional man the knowledge of detail. Thus has arisen the science of large numbers or statistics, and the many methods of which it is possessed." [1]

The contrast, indicated by Merz, between the experimental method of the natural sciences and the statistical method of the social sciences may be expressed in greater detail. The natural scientist sets up and tries his experiment; repeats it as often as he pleases under the same or varying conditions; isolates the factor in which he is interested; and arrives at a demonstrable conclusion concerning the operation and effects of that factor. The social scientist, on the other hand, must accept and analyze the mixed situation as it comes to him; gather pertinent statistics, not such as he would like, but such as are available; study figures which embody the combined effects of many factors; and express his conclusions in terms of probabilities.

[1] John T. Merz, *History of European Thought in the Nineteenth Century*, vol. II, pp. 554–55.

It is obvious that the scope and nature of statistical inquiries are determined, in the first instance, by the extent and kind of records yielded by the "relentlessly hurrying stream of events." Many of these records, which constitute the material for statistical research, are the result of accident rather than of design. For instance, in the seventeenth century, the French Government sold bonds containing the provision that, upon the death of any holder, the income from his bond was to be distributed to the surviving holders. The record of this bond issue constituted the material for one of the first tables of mortality. But we need not go back to the seventeenth century for illustrations of the accidental origin of useful statistics. Our figures for the personal distribution of incomes are a by-product of tax administration; bank clearings are a consequence of the process of check collection; and figures for building permits have resulted from the regulation of urban construction. It is only in comparatively recent times that such statistical by-products have been supplemented by special collections of data definitely designed to answer specific social or economic questions. And it is a still more recent development for various organizations, such as journals, trade associations, and governmental agencies, to collect and publish current data expressly for the purpose of estimating tendencies with the object of moulding private and public policies. The body of new statistics which has been added to our store during the five years since the War shows that we are making rapid progress toward securing a more adequate statistical record of "the relentlessly hurrying stream of events."

The boundaries of statistical research set by the available material are obviously being widened, particularly in the field of economics. But it is not now my purpose to

consider either these widening boundaries or their limitations upon research. My purpose, as I have said, is to consider the nature of the argument which proceeds from an examination of series of economic statistics, such as prices, interest rates, and the output of goods for consecutive time-units in a given period.

Statistical devices, such as tables, charts, averages, measures of dispersion, lines or curves of trend, periodic functions, and coefficients of correlation, are not arguments. All this machinery enables one merely to describe more or less completely and, at the same time, more or less simply, the economic fluctuations and interrelations of the given period. The inclusion of such a function as the coefficient of correlation among the descriptive devices of statistics indicates and emphasizes our point of view. Keynes accurately characterizes the last named statistical device in these words, "the mere existence of a particular correlation coefficient as descriptive of a group of observations, even of a large group, is not in itself a more conclusive or significant argument than the mere existence of a particular frequency coefficient would be." [1] And a frequency coefficient, such as average wholesale prices or the ratio between bank loans and deposits, is of itself no argument at all. In short, the immediate result of any research in social statistics is merely the description of a limited field.

But the statistician whom we are considering has not as his object the securing of an isolated description in a world of isolated descriptions. His aim is to draw an inference. In the specific case which we are considering, his object is the definite one of getting a notion of the economic "prospects of society." To attain his end, he has selected a suitable body of statistics and a period

[1] See J. M. Keynes, *A Treatise on Probability*, pp. 327, 426.

for study. Back of this selection, back of the study itself, is a fundamental belief. The statistician, in common with every other scientific investigator, has a deep-seated belief in the continuity and orderliness of affairs.

"The grasp of large numbers," says Merz, "the methodical array of figures and the registration of events would in itself be of little use, were it not for a fundamental assumption which appeals to common sense and has been confirmed by science, though it is hardly anywhere expressly stated, namely, the belief in a general order, in a recurrent regularity, or a slow but continuous change and orderly development of the things and events of the world. . . . It may also be well to note that this belief in a general order is common to all schools of thought."[1]

The recognition of this belief in a general orderliness of affairs is necessary if we are to understand the manner in which the statistician moulds his investigation and arrives at a statistical inference. In the first place, he follows, as well as his material allows, the method of the experimental scientist when he selects, as a basis for forecasting, a past period for study as nearly as possible like that of the present. He attempts to find a specific analogy existing in an orderly universe. But he realizes that analogies differ greatly in their persuasive quality. The importance for an inference of a given statistical result pertaining to a given period is greatly increased, first, if similar or consistent statistical results obtain for sub-periods; second, if similar or consistent statistical results obtain for other periods and under different circumstances; and third, if all the statistical results agree with, are supported by, or can be set in the framework of, related knowledge

[1] John T. Merz, *History of European Thought in the Nineteenth Century*, vol. II, p. 556.

of a statistical or non-statistical nature. To illustrate the first point, if we have found that a periodic function with a period of forty months fits a time series of money rates for a span of fifty years, the conclusion that there is a real period of forty months for the entire span is strengthened if we obtain the same periodic function for each of two or more segments of the given fifty years. To illustrate the second point, the conclusion is further strengthened if the same function is found for other than the given fifty-years span and its segments. The conclusion of a forty-months period would be further supported by the securing of evidence, statistical or otherwise, of corresponding fluctuations in business affairs. In other words, stability of statistical results and agreement with non-statistical results are potent arguments for continued stability in an orderly universe.

The method of argument just described is essentially empirical. Oftentimes when arguments from statistics are so characterized, the word "empirical" is used as a derogatory epithet; that is, with the intent of classifying statistical inference as a lower, and hardly respectable, order of human thought. It is not in this way that I use the term. For I conceive that the term "empirical" "means simply what belongs to or is the product of experience or observation," and that a stable empirical statistical result, persisting over the entire range of our experience, is precisely the same thing as a "law of nature."

You will say to me, "There is nothing novel in the type of argument which you ascribe to the statistician; it is induction, neither more nor less." To this I assent. "But the statistician," you may continue, "unlike other investigators, deals with large numbers relating to classes of phenomena in which, though it is impossible to predict what will happen in an individual case, there is neverthe-

less a significant regularity of occurrence if the phenomena be considered in successive sets. From this regularity," you say, "and from the likeness of the stream of human events to games of chance, the mathematician has built up a technique of statistical probability. In this technique, a given statistical series becomes a random sample; and the various statistical devices used, such as averages and coefficients of correlation, consequently have determinable probable errors. From these probable errors we can state precisely the future result which we may reasonably expect. For instance," you continue, "the maximum coefficient of correlation between the monthly items of pig-iron production and money rates for the period January, 1903, to July, 1914 (133 pairs of items), after having made due allowance for secular trend and seasonal influences, is for a lag of five or six months in money rates and amounts to + 0.75. The probable error of this coefficient is 0.03. The coefficient of correlation and the probable error together mean, according to the theory of inverse probability, that if we should take another sample of equal size, the chances are equal that the resulting coefficient would be between + 0.72 and + 0.78. That is to say, one can state the mathematical probability that given economic relations will obtain in the future. This," you conclude, "is the special contribution of mathematical statistics to forecasting."

The view that the mathematical theory of probability provides a method of statistical induction or aids in the specific problem of forecasting economic conditions, I believe, is wholly untenable. Let us take a simple case. Suppose we are considering the probability that the year 1924, for example, will be a year of business depression and that we have the record of business conditions for the past one hundred years in which there were forty years of

depression and sixty years of non-depression. Then, according to the statistical record, the probability that a year taken at random would be depressed is 4/10. But this probability cannot refer to 1924 unless that year is a random year; that is, unless we have no specific information that differentiates it from other years. In fact, we do have specific information about the economic conditions in 1923 and about the relation of economic conditions in consecutive years, which we cannot reasonably ignore, so that we cannot view 1924 as "any" year taken at random. Every item of knowledge which we obtain bearing upon the situation in 1923 removes not only that year, but also the following year, one step further from its classification as "random." Such items of knowledge do not lead merely to continued revisions of the numerical probability that 1924 will be a year of depression; rather, they render inapplicable the method of mathematical probability to the problem of making a rational forecast. Moreover, the actual statistical data utilized as a basis for forecasting economic conditions, such as a given time series of statistics for a selected period in the past, cannot be considered a random sample except in an unreal, hypothetical sense; that is to say, unless assumptions be made concerning our material which cannot be retained in actual practice. Any past period that we select for study is, in fact, a special period with characteristics distinguishing it from other periods, and is not "random" with respect to the present. We must, therefore, discard statistical probability and, in any year, arrive at a forecast for the following year on another basis.

There is a special objection to the application of the theory of probability to the particular economic data which constitute our material. If the theory of probability is to apply to our data, not merely the series but the indi-

vidual items of the series must be a random selection. In fact, a group of successive items with a characteristic conformation constitutes our material. Since the individual items are not independent, the probable errors of the constants of a time series, computed according to the usual formulas, do not have their usual mathematical meaning. Thus, the "probable error" of 0.03, in a coefficient of correlation of +0.75 between the monthly items of pig-iron production and money rates six months later, does not indicate, as one would conclude from the theory of probability, that the chances are billions to one against the independence of the two variables; or, to state the idea more specifically, that if we compute a coefficient from data of "any" other actual period the chances are more than ten millions to one that its value would be over +0.50. In fact, the significance of the "probable error" of a constant computed from time series is not known and, in practice, we do not view the world from the standpoint of mathematical probability. So that we are not surprised when we actually find that the coefficient of correlation between the adjusted figures for pig-iron production and money rates six months later for the period 1915–18 is only +0.38. We find sufficient explanation of this result, which is almost impossible and really astounding when viewed from the standpoint of random sampling, in the War demands for pig-iron, the tremendous imports of gold, government financing, and the inauguration of the Federal Reserve System during the period in question. Neither are we surprised when we find that, for the period 1919–23, the maximum correlation between the two series is for a lag in money rates, not of six months, but of nine to twelve months. For this period includes the severe crisis and great financial stringency of 1920–21, which dominated most of

the items and hence the results. Thus, in actual practice, the statistician cannot reasonably assume ignorance of the peculiar circumstances pertaining to the special cases which constitute his material, and therefore he does not think in terms of random sampling and numerical probabilities. Granting, as he must, that consecutive items of a statistical time series are, in fact, related, he admits that the mathematical theory of probability is inapplicable.

The thesis that statistical probabilities give us no aid in arriving at a statistical inference has been developed with great skill and, I think, success by John Maynard Keynes in his *Treatise on Probability.* Summarizing his position, he says: "In order to get a good scientific argument, we still have to pursue precisely the same methods of experiment, analysis, comparison, and differentiation as are recognized to be necessary to establish any scientific generalization. These methods are not reducible to a precise mathematical form. . . . But that is no reason for ignoring them, or for pretending that the calculation of a probability which takes into account nothing whatever except the numbers of instances, is a rational proceeding. . . . Generally speaking, therefore, I think that the business of statistical technique ought to be regarded as strictly limited to preparing the numerical aspects of our material in an intelligible form, so as to be ready for the application of the usual inductive methods. Statistical technique tells us how to 'count the cases' when we are presented with complex material. It must not proceed also, except in the exceptional case where our evidence furnishes us from the outset with data of a particular kind, to turn its results into probabilities; not, at any rate, if we mean by probability a measure of rational belief." [1]

[1] J. M. Keynes, *A Treatise on Probability*, pp. 391–92.

For the purposes of drawing inferences from economic statistics, in which the data are not of the "particular kind" indicated by Keynes, the theory of numerical probability gives no assistance. In particular, reasonable forecasts of economic developments can only be made by application of the usual methods of argument. To be sure, the conclusions of such arguments are expressed, not as certainties, but as probabilities. They are not, however, numerical probabilities. It is obviously impossible to state, in terms of numerical probability, a forecast or an inference based upon both qualitative and quantitative evidence; and even if all the evidence were quantitative, we have seen that it does not express a numerical measure of rational belief for the future. So when we say that "the conclusions of the social scientist are expressed in terms of probabilities" we mean merely that his conclusions do not have the certainty of those of the natural scientist. The probabilities of the economic statistician are not the numerical probabilities which arise from the application of the theorems of Bernoulli and Bayes; they are, rather, non-numerical statements of the conclusions of inductive arguments.

CHAPTER II

TRADE CYCLES AND FACTORY PRODUCTION

By WILLFORD I. KING[1]

PREVIOUS to the last decade, our chief sources of information utilizable for a study of the business cycle were records of wholesale prices and of factory production. During the last few years, however, a mass of new statistical data has appeared — data pertaining to many and varied lines of activity. Although, in earlier years, for example, the United States Bureau of Labor Statistics published retail price indexes covering food only, since 1914 it has also compiled data showing the changes occurring in the prices of all types of commodities used by urban employees. More recently, the National Industrial Conference Board has collected similar information. As a result of these studies, our knowledge of the course of prices at retail has been greatly improved.

The National Bureau of Economic Research has been doing a limited amount of work along the same line — work which has resulted in adding to the list of index numbers at our disposal new ones showing the fluctuations in the values of those goods sold to the wealthier sections of our population, and to farm dwellers, in contradistinction to other indexes pertaining to goods sold primarily to urban workers.

One of the most notable contributions to our knowledge of the cycle made during the last five years is the information concerning fluctuations in the sales of retail and wholesale stores, compiled by the Federal Reserve

[1] Statistical work by Maurice Leven and Elizabeth W. Putnam.

Board. These figures go back to the beginning of 1919. Miss Elizabeth W. Putnam, of the National Bureau of Economic Research, has endeavored to give more breadth to the picture by collecting, from a considerable number of firms, records of their annual sales for the years 1909 to date. In addition to the studies just mentioned, both the Harvard Economic Service and the New York Federal Reserve Bank have greatly aided in solving the puzzle of the business cycle by furnishing detailed monthly figures showing the variations in manufacturing production. Is it possible to combine the mass of information now available in such a manner as to throw new light upon the causes underlying the business cycle?

A question of distinct interest to the student of business cycles is the rôle of retail activity in the cycle. Are fluctuations in retail prices and trade causative factors, or are they merely resultants of other forces? The answer to this question obviously involves the whole matter of the nature of the cycle.

Does the cycle have its origin in physical or in psychical forces? If the business cycle is a result of variations of rainfall, then it seems rather clear that we must look elsewhere than to retail prices or retail trade for the ultimate motive force that generates the cycle. Even so, however, it might well be that crop variations would be transmitted to urban business mainly by causing changes in the ability of farmers and others to buy goods at retail. In this case, retail trade would be at most only a secondary and not a primary causal factor. To adopt the hypothesis that the ups and downs of business are caused by changes developing within urban business itself, although it confines our inquiry to much narrower bounds, still leaves us just as much in doubt as to whether trade is the aftermath of manufacturing activity, or whether,

instead, trade gives rise to factory production. This query resembles that raised by Adam Smith: whether surplus production gives rise to the exchange of goods, or whether the exchange of goods makes surplus production possible. Perhaps, before we finish this topic, those facetiously inclined may feel that our question is even more closely allied to that much older one, "Which came first, the hen or the egg?"

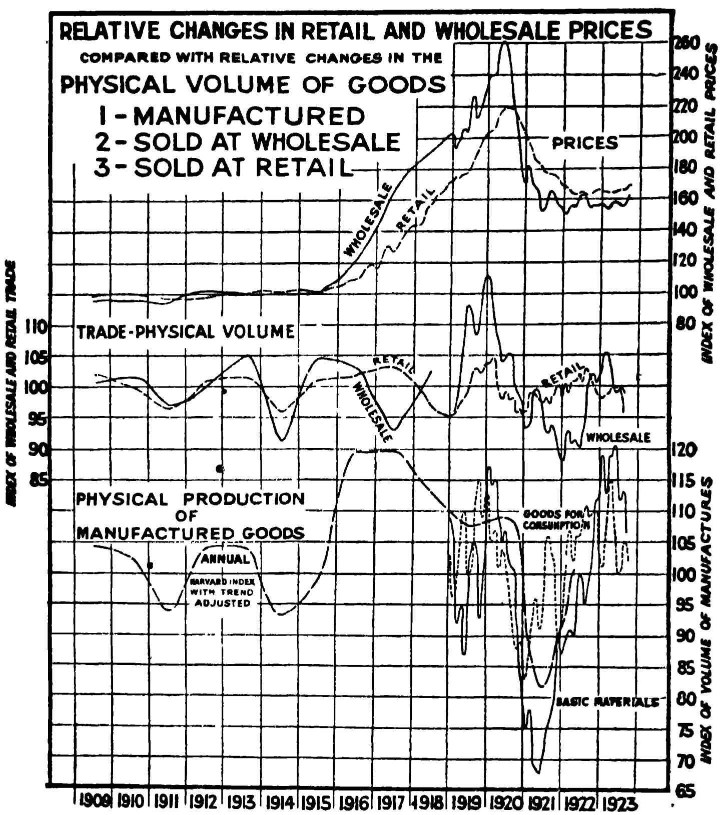

FIGURE 1. CHANGES IN PRICES COMPARED WITH CHANGES IN PHYSICAL VOLUME OF GOODS

It has been commonly assumed that, since oscillations in retail prices occur at a later date than do corresponding ones in wholesale prices, retail trade must be a resultant of forces passed on from the factory. That such a price sequence really occurs seems to be indicated rather clearly by the curves shown in the upper part of Figure 1. It will be demonstrated later, however, that it is unsafe to assume that the earlier of two related events is always the cause of the later.

At this point, it seems necessary to digress in order to explain the nature of the curves shown on the figure. The wholesale price curve from January, 1919, to date represents the index of the wholesale prices of consumers' goods as calculated by the Federal Reserve Board. The curve has been extended back to 1909 by adjusting to a comparable base the United States Bureau of Labor Statistics index of wholesale prices of manufactured commodities. The retail price curve here given is original with the National Bureau of Economic Research. It has been computed by combining in a weighted average the following three indexes:

(1) Prices of goods consumed by families spending $25,000 a year for consumption goods.
(2) Prices of goods consumed by families spending $5000 a year for consumption goods.
(3) Prices of goods consumed by urban employees.[1]

These indexes have been computed only for January first and July first of each year. Interpolations during recent years have been made by aid of the "Cost of Living" indexes furnished by the United States Bureau of Labor Statistics and the National Industrial Conference Board.

[1] For years since 1913, based upon United States Bureau of Labor Statistics indexes.

The curves in the middle of the chart (Figure 1), showing cyclical fluctuations in the physical volume of trade, have been derived by first dividing the money value of sales for each period by the corresponding price index [1] for the middle of the period, and then eliminating from the resulting series both the trend and seasonal fluctuations.

TABLE 1. CYCLICAL MOVEMENT IN PHYSICAL VOLUME OF MANUFACTURE
1889–1921

YEAR	UNADJUSTED INDEXES OF PHYSICAL VOLUME OF MANUFACTURE			SMOOTH TREND	PER CENT OF NORMAL $\frac{C}{D}$
	1909–13 = 100	1919 = 100	1913 = 100		
	A	B	C	D	E
1889	58.4[a]	43.3[c]	53.5	53.10	100.75
1900	59.0[a]	43.8[c]	54.1	56.18	96.30
1901	65.6[a]	48.7[c]	60.1	59.26	101.42
1902	72.1[a]	53.5[c]	66.4	62.34	106.51
1903	73.3[a]	54.4[c]	67.2	65.42	102.72
1904	71.9[a]	53.3[c]	65.8	68.50	96.06
1905	84.3[a]	62.5[c]	77.2	71.58	107.85
1906	90.5[a]	67.1[c]	82.8	74.66	110.90
1907	91.3[a]	67.7[c]	83.6	77.74	107.54
1908	77.5[a]	54.5[c]	67.3	80.82	83.27
1909	95.4[a]	70.8[c]	87.4	83.90	104.17
1910	96.9[a]	71.9[c]	88.8	86.68	102.45
1911	92.4[a]	68.5[c]	84.6	90.06	93.94
1912	105.9[a]	78.6[c]	97.0	93.14	104.14
1913	109.2[a]	81.0[c]	100.0	96.22	103.93
1914	101.1[a]	75[b]	92.6	99.30	93.25
1915		86[b]	101.7	102.38	99.33
1916		102[b]	125.9	105.46	119.38
1917		105[b]	129.6	108.54	119.40
1918		102[b]	125.9	111.62	112.79
1919		100[b]	123.5	114.70	107.67
1920		104[b]	128.4	117.78	109.01
1921		80[b]	98.8	120.86	81.75

[a] Table XXIV, p 55, "An Index of the Physical Volume of Production," 1921. (Reprinted from *Harvard Review of Economic Statistics*, September, 1920, January, 1921), E. E Day

[b] Table C, p. 198, *Harvard Review of Economic Statistics*, July, 1923.

[c] A × 0.741839 (ratio of B to A in 1914)

[1] That described in the preceding paragraphs.

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Year	Unadjusted Indexes of Physical Volume of Manufacture			Smooth Trend	Per Cent of Normal $\frac{C}{D}$
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	A	B	C	D	E
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1903	73.3[a]	54.4[c]	67.2	65.42	102.72
1904	71.9[a]	53.3[c]	65.8	68.50	96.06
1905	84.3[a]	62.5[c]	77.2	71.58	107.85
1906	90.5[a]	67.1[c]	82.8	74.66	110.90
1907	91.3[a]	67.7[c]	83.6	77.74	107.54
1908	77.5[a]	54.5[c]	67.3	80.82	83.27
1909	95.4[a]	70.8[c]	87.4	83.90	104.17
1910	96.9[a]	71.9[c]	88.8	86.68	102.45
1911	92.4[a]	68.5[c]	84.6	90.06	93.94
1912	105.9[a]	78.6[c]	97.0	93.14	104.14
1913	109.2[a]	81.0[c]	100.0	96.22	103.93
1914	101.1[a]	75[b]	92.6	99.30	93.25
1915		86[b]	101.7	102.38	99.33
1916		102[b]	125.9	105.46	119.38
1917		105[b]	129.6	108.54	119.40
1918		102[b]	125.9	111.62	112.79
1919		100[b]	123.5	114.70	107.67
1920		104[b]	128.4	117.78	109.01
1921		80[b]	98.8	120.86	81.75

[a] Table XXIV, p. 55, "An Index of the Physical Volume of Production," 1921. (Reprinted from *Harvard Review of Economic Statistics*, September, 1920, January, 1921), E. E. Day.
[b] Table C, p. 198, *Harvard Review of Economic Statistics*, July, 1923
[c] A × 0.741839 (ratio of B to A in 1914)

[1] That described in the preceding paragraphs.

TABLE 2. CYCLICAL MOVEMENT IN THE PHYSICAL VOLUME OF WHOLESALE TRADE
1909–1923

	A	B	C	D	E	F	G	H
			INDEXES OF VOLUME OF SALES					
DATE	INDEX OF VALUE OF SALES	PRICE INDEX	Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
1909	.71[a]	.95[d]	.74	.74	1.00			
1910	.79[a]	.96[d]	.82	.81	1.01			
1911	.80[a]	.95[d]	.84	.87	.97			
1912	.93[a]	1.01[d]	.91	.91	1.00			
1913	1.00[a]	1.00[f]	1.00	.95	1.05			
1914	.99[a]	1.00[d]	.89	.97	.91			
1915	1.05[a]	1.01[d]	1.04	.99	1.04			
1916	1.28[a]	1.21[de]	1.05	1.02	1.03			
1917	1.67[a]	1.67[de]	.99	1.07	.93			
1918	2.24[a]	1.92[de]	1.16	1.13	1.02			
1919	2.74[a]	2.11[f]	1.30	1.20	1.07			
Jan.	2.16[b]	2.03[g]	1.06	1.17	.90	.91	.98	
Feb.	1.95[b]	1.93[g]	1.01	1.17	.85	.88	.97	.96
Mar.	2.19[b]	1.98[g]	1.10	1.18	.93	1.01	.92	.98
Apr.	2.42[b]	2.02[g]	1.20	1.19	1.00	.94	1.06	1.02
May	2.59[b]	2.06[g]	1.26	1.19	1.05	.96	1.09	1.09
June	2.84[b]	2.04[g]	1.39	1.20	1.15	1.01	1.13	1.13

[a] Based on sales of representative companies.
[b] Federal Reserve Index of Wholesale Trade (adjusted to correspond with yearly data) from *Federal Reserve Bulletin*, April, 1923, p. 441.
[d] Data from Bulletin 296 of United States Bureau of Labor Statistics, p. 8. Food weighted, 5; cloths and clothing, 3; fuel and light, 1; house furnishings, 1.
[e] Adjusted to meet Federal Reserve Index in 1919.
[f] *Federal Reserve Bulletin*, April, 1923, p. 491.
[g] *Federal Reserve Bulletin*, February, 1920, p. 169. Adjusted in accordance with subsequent corrected yearly figures.

TABLE 2. CYCLICAL MOVEMENT IN THE PHYSICAL VOLUME OF WHOLESALE TRADE (*continued*)

1909–1923

	A	B	C	D	E	F	G	H
			INDEXES OF VOLUME OF SALES					
DATE	INDEX OF VALUE OF SALES	PRICE INDEX	Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
July	3.08[b]	2.17[g]	1.42	1.20	1.17	.99	1.18	1.12
Aug.	3.04[b]	2.27[g]	1.33	1.21	1.10	1.05	1.04	1.10
Sept.	3.13[b]	2.13[g]	1.47	1.22	1.20	1.11	1.08	1.08
Oct.	3.33[b]	2.15[g]	1.55	1.22	1.26	1.12	1.12	1.10
Nov.	3.04[b]	2.22[g]	1.37	1.23	1.11	1.01	1.10	1.15
Dec.	3.37[b]	2.30[g]	1.46	1.23	1.18	.95	1.23	1.17
1920			1.33					
Jan.	3.29[b]	2.40[h]	1.37	1.24	1.10	.91	1.19	1.17
Feb.	2.89[b]	2.40[h]	1.20	1.25	.96	.88	1.09	1.14
Mar.	3.46[b]	2.41[h]	1.43	1.25	1.14	1.01	1.13	1.09
Apr.	3.27[b]	2.57[h]	1.27	1.26	1.01	.94	1.06	1.07
May	3.24[b]	2.61[h]	1.24	1.26	.98	.96	1.01	1.03
June	3.40[b]	2.55[h]	1.33	1.27	1.04	1.01	1.03	1.04
July	3.44[b]	2.50[h]	1.37	1.27	1.07	.99	1.08	1.05
Aug.	3.21[b]	2.29[h]	1.40	1.28	1.09	1.05	1.03	1.05
Sept.	3.21[b]	2.18[h]	1.47	1.28	1.14	1.11	1.03	1.00
Oct.	2.76[b]	2.03[h]	1.36	1.29	1.05	1.12	.93	.99
Nov.	2.50[b]	1.87[h]	1.33	1.29	1.03	1.01	1.02	.97
Dec.	2.06[b]	1.71[h]	1.20	1.30	.92	.95	.96	.95

[b] Federal Reserve Index of Wholesale Trade (adjusted to correspond with yearly data) from *Federal Reserve Bulletin*, April, 1923, p. 441.
[g] *Federal Reserve Bulletin*, February, 1920, p. 169. Adjusted in accordance with subsequent corrected yearly figures.
[h] *Federal Reserve Bulletin*, March, 1921, p. 330.

TABLE 2. CYCLICAL MOVEMENT IN THE PHYSICAL VOLUME OF WHOLESALE TRADE (*continued*)

1909–1923

	A	B	C	D	E	F	G	H
			INDEXES OF VOLUME OF SALES					
DATE	INDEX OF VALUE OF SALES	PRICE INDEX	Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
1921			1.25					
Jan.	1.88[b]	1.82[ı]	1.03	1.30	.79	.91	.86	.93
Feb.	1.90[b]	1.71[ı]	1.11	1.31	.84	.88	.96	.93
Mar.	2.21[b]	1.68[ı]	1.31	1.32	.99	1.01	.98	.98
Apr.	2.03[b]	1.59[ı]	1.27	1.32	.96	.94	1.01	.99
May	1.94[b]	1.53[ı]	1.27	1.33	.95	.96	.99	.98
June	1.99[b]	1.54[i]	1.29	1.33	.97	1.01	.95	.95
July	1.95[b]	1.62[i]	1.20	1.34	.89	.99	.90	.93
Aug.	2.20[b]	1.67[i]	1.32	1.34	.98	1.05	.93	.92
Sept.	2.25[b]	1.62[i]	1.39	1.35	1.03	1.11	.92	.93
Oct.	2.30[b]	1.58[i]	1.45	1.35	1.07	1.12	.95	.91
Nov.	1.87[b]	1.57[i]	1.19	1.36	.88	1.01	.87	.89
Dec.	1.70[b]	1.53[i]	1.11	1.36	.81	.95	.85	.88
1922			1.33					
Jan.	1.76[b]	1.50[i]	1.17	1.37	.85	.91	.93	.90
Feb.	1.72[b]	1.55[i]	1.11	1.37	.81	.88	.92	.92
Mar.	2.04[b]	1.57[i]	1.30	1.38	.94	1.01	.93	.91
April	1.80[b]	1.56[i]	1.15	1.38	.83	.94	.88	.91
May	1.99[b]	1.60[i]	1.24	1.39	.89	.96	.93	.90

[b] Federal Reserve Index of Wholesale Trade (adjusted to correspond with yearly data) from *Federal Reserve Bulletin*, April, 1923, p. 441.
[ı] *Federal Reserve Bulletin*, October, 1921, p. 1203.
[i] *Federal Reserve Bulletin*, November, 1921, p. 1206.

Table 2. Cyclical Movement in the Physical Volume of Wholesale Trade (*continued*)

1909–1923

Date	A	B	C	D	E	F	G	H
	Index of Value of Sales	Price Index	Indexes of Volume of Sales					
			Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
June	2 11[b]	1 64[i]	1 28	1.39	92	1.01	.90	.90
July	1 98[c]	1 63[i]	1.21	1 39	.86	.99	.87	.92
Aug.	2 29[c]	1 56[i]	1.47	1.40	1.04	1.05	.99	.95
Sept.	2 42[c]	1.54[i]	1.57	1.40	1 11	1.11	1.00	1.00
Oct.	2.53[c]	1.56[i]	1 62	1.40	1.15	1.12	1.01	1.02
Nov.	2.30[c]	1.56[i]	1.47	1.41	1.04	1.01	1.03	1.00
Dec.	2.06[c]	1.57[i]	1.31	1.42	.92	.95	.96	1.01
1923			1.50[k]					
Jan.	2.14[c]	1.56[i]	1.37	1.42	.96	.91	1.04	1.02
Feb.	2.08[c]	1.54[i]	1.35	1.43	.94	.88	1.07	1.05
Mar.	2 36[c]	1.55[i]	1.52	1.43	1.05	1.01	1.04	1.04
April	2.17[c]	1.58[i]	1.37	1.44	.95	.94	1.00	1.01
May	2.19[c]	1.58[i]	1.39	1.44	.96	.96	.99	.99
June	2.30[c]	1.57[i]	1.46	1.45	1.01	1.01	.99	.99
July	2.19[c]	1.55[i]	1.41	1.45	.97	.99	.97	.99
Aug.	2.47[c]	1.57[i]	1.57	1.46	1.07	1.05	1.01	.99
Sept.	2.58[c]	1 62[i]	1.59	1.46	1.08	1.11	.97	

[b] Federal Reserve Index of Wholesale Trade (adjusted to correspond with yearly data) from *Federal Reserve Bulletin*, April, 1923, p. 441.
[c] Federal Reserve Index of Wholesale Trade (adjusted to correspond with yearly data) from *Federal Reserve Bulletin*, November, 1923, p. 2222.
[i] *Federal Reserve Bulletin*, November, 1921, p. 1206.
[k] Estimated on basis of nine months.

Table 3. Cyclical Movement in the Physical Volume of Retail Trade
1909–1923

	A	B	C	D	E	F	G	H
			Indexes of Volume of Sales					
Date	Index of Value of Sales	Price Index	Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
1909	55.88[a]	98.41	.56	.55	1.01			
1910	64.10[a]	100.19	.63	.64	.99			
1911	69.44[a]	97.41	.71	.73	.96			
1912	84.28[a]	97.35	.86	.85	1.00			
1913	100.00[a]	100.00	1.00	.98	1.01			
1914	110.39[a]	101.39	1.08	1.13	.95			
1915	133.86[a]	101.35	1.32	1.30	1.01			
1916	166.51[a]	110.06	1.51	1.48	1.01			
1917	215.59[a]	130.76	1.64	1.59	1.03			
1918	251.32[a]	155.77	1.92	1.67	.96			
1919	322.65[a]	183.21	1.76		1.01			
Jan.	249.76[b]	172.90	1.44	1.70	.84	.86	.97	
Feb.	237.83[b]	175.72	1.35	1.71	.79	.82	.95	.95
Mar.	284.54[b]	173.85	1.63	1.72	.95	1.02	.92	.96
April	307.87[b]	176.68	1.74	1.72	1.00	1.00	1.00	.97

[a] Based on sales of sample companies.
[b] *Federal Reserve Bulletin*, January, 1923, p. 104. Department stores weighted 3; mail-order houses, 1; groceries, 1; five and ten, 1; drug, 1; cigar, 1 shoes, 1; music, 1.

TABLE 3. CYCLICAL MOVEMENT IN THE PHYSICAL VOLUME OF RETAIL TRADE (*continued*)

1909–1923

	A	B	C	D	E	F	G	H
			Indexes of Volume of Sales					
Date	Index of Value of Sales	Price Index	Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
May	305 84[b]	176 69	1 73	1.73	.99	1.00	.99	.98
June	285.19[b]	178.13	1.60	1.74	.91	.95	.96	.99
July	277 54[b]	181.18	1.53	1.74	.87	.85	1.02	1.00
Aug.	290.39[b]	184.86	1.57	1.75	.89	.86	1.03	1.02
Sept.	319.75[b]	188.85	1.69	1.76	.95	.93	1.02	1.03
Oct.	395.12[b]	192.38	2.05	1.77	1.15	1.11	1.03	1.02
Nov.	390.83[b]	196.40	1 99	1.78	1.11	1.09	1.02	1.02
Dec.	524.02[b]	200.21	2 61	1.79	1.46	1.45	1.00	1.03
1920	386.99	210.85	1.83					
Jan.	341.01[b]	201.97	1.68	1.80	.93	.86	1.08	1.04
Feb.	314.04[b]	203.71	1.54	1.81	.85	.82	1.03	1.04
Mar.	393.79[b]	205.47	1.91	1.82	1.05	1.02	1.02	1.01
April	381.31[b]	210.61	1.81	1.83	.98	1.00	.98	.99
May	392.63[b]	216.46	1.81	1.84	.98	1.00	.98	.98
June	376.73[b]	218.60	1.72	1.85	.93	.95	.97	.99

[b] *Federal Reserve Bulletin*, January, 1923, p. 104. Department stores weighted, 3; mail-order houses, 1; groceries, 1; five and ten, 1; drug, 1; cigar, 1; shoes, 1; music, 1.

TABLE 3. CYCLICAL MOVEMENT IN THE PHYSICAL VOLUME OF RETAIL TRADE (*continued*)

1909–1923

	A	B	C	D	E	F	G	H
			INDEXES OF VOLUME OF SALES					
DATE	INDEX OF VALUE OF SALES	PRICE INDEX	Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
July	352 43[b]	219 12	1 60	1.86	.86	.85	1 01	.98
Aug.	338 04[b]	217.71	1 55	1.87	.82	.86	95	.98
Sept.	371 40[b]	214 99	1.72	1.88	.91	.93	97	.96
Oct.	424 35[b]	211.18	2 00	1 89	1.05	1.11	.94	.96
Nov.	423.83[b]	207.45	2.04	1 90	1 07	1 09	.97	.95
Dec.	534.21[b]	202.92	2.63	1.92	1.37	1.45	.94	.96
1921	356.69	180.20	1.97					
Jan.	318 29[b]	197.95	1.60	1.93	.83	.86	.96	.96
Feb.	298.81[b]	190 34	1.56	1.94	80	.82	.98	.98
Mar.	378.02[b]	185 63	2.03	1.95	1.04	1.02	1.01	.99
April	360.43[b]	184.42	1.95	1 97	.99	1.00	.98	.98
May	346.85[b]	182.32	1.90	1 98	.95	1.00	.95	.98
June	338.40[b]	177.70	1.90	2 00	.95	.95	1.00	.97
July	296.16[b]	177.48	1.66	2 01	.82	.85	.96	.98
Aug.	305.94[b]	176.88	1.72	2 03	.85	.86	.98	.97

[b] *Federal Reserve Bulletin*, January, 1923, p. 104. Department stores weighted, 3; mail-order houses, 1; groceries, 1; five and ten, 1; drug, 1; cigar, 1; shoes, 1; music, 1.

TABLE 3. CYCLICAL MOVEMENT IN THE PHYSICAL VOLUME OF RETAIL TRADE (*continued*)

1909–1923

	A	B	C	D	E	F	G	H
			INDEXES OF VOLUME OF SALES					
DATE	INDEX OF VALUE OF SALES	PRICE INDEX	Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
Sept.	327 49[b]	176 53	1 85	2 04	.90	.93	97	.98
Oct.	401.83[b]	172 60	2 32	2 06	1 13	1 11	1 01	98
Nov.	380.79[b]	170 72	2.23	2 07	1 07	1.09	98	1.00
Dec.	527.15[b]	169 91	3.10	2.09	1 48	1.45	1.01	.98
1922	373.85	164.33	2.27					
Jan.	302.06[b]	167 20	1.80	2 11	85	.86	.98	1.00
Feb.	292 58[b]	164 48	1 77	2 13	.83	.82	1 01	.98
Mar.	348.72[b]	163.20	2.13	2 15	.99	1 02	.96	1 00
April	375 63[b]	163 30	2.30	2.18	1.05	1.00	1 04	1.00
May	366.66[b]	163 47	2.24	2 20	1.01	1.00	1.01	1.01
June	347.07[b]	163 90	2.11	2 23	.95	.95	99	1.00
July	319 81[b]	164 51	1.94	2.25	.86	.85	1.00	1.00
Aug.	328.68[b]	162.87	2.01	2.28	.88	.86	1 01	1.02
Sept.	373.34[b]	163.41	2.28	2.31	.98	.93	1 05	1.01
Oct.	421.54[b]	164.41	2.56	2.34	1.09	1.11	.97	1.00

[b] *Federal Reserve Bulletin*, January, 1923, p. 104. Department stores weighted, 3; mail-order houses, 1; groceries, 1; five and ten, 1; drug, 1; cigar, 1; shoes, 1; music, 1.

TABLE 3. CYCLICAL MOVEMENT IN THE PHYSICAL VOLUME OF RETAIL TRADE (*continued*)

1909–1923

Date	A	B	C	D	E	F	G	H
			Indexes of Volume of Sales					
	Index of Value of Sales	Price Index	Preliminary Index $\frac{A}{B}$	Smooth Trend based on Moving Average	Fraction of Normal $\frac{C}{D}$	Seasonal Factor in E	Cyclical Movement $\frac{E}{F}$	3 Months' Moving Average of G
Nov.	421.32[b]	165.20	2.55	2.37	1.07	1.09	.98	.99
Dec.	588.90[c]	166.01	3.54	2.40	1.47	1.45	1.01	.98
1923			2.56[e]					
Jan.	351.60[c]	165.70	2.00	2.43	.82	.86	.95	.98
Feb.	328.15[c]	165.51	1.98	2.46	.80	.82	.97	.98
Mar.	435.50[c]	165.41	2.63	2.49	1.05	1.02	1.03	.98
April	401.76[c]	165.70	2.42	2.52	.96	1.00	.95	.99
May	430.05[c]	166.00	2.59	2.55	1.01	1.00	1.01	.99
June	419.43[c]	166.30	2.52	2.58	.97	.95	1.02	.99
July	355.50[c]	166.58	2.13	2.61	.81	.85	.95	.98
Aug.	378.00[c]	166.87	2.26	2.64	.85	.86	.98	.95
Sept.	406.60[c]	168.35	2.41	2.77	.87	.93	.93	
Oct.		168.62						

[b] *Federal Reserve Bulletin*, January, 1923, p. 104. Department stores weighted, 3; mail-order houses, 1; groceries, 1; five and ten, 1; drug, 1; cigar, 1; shoes, 1; music, 1.

[c] *Federal Reserve Bulletin*, March, 1923, p. 374. Weighted as above.

[e] Estimated on basis of nine months.

Owing, perhaps, to the fact that we have records for only four complete years, but probably to irregularities in seasonal fluctuations in trade, the resulting curves were quite irregular; and hence, in order to bring out the chief cyclical movements, a three-months moving average has been applied to the original monthly figures for both wholesale and retail trade. No such treatment was necessary for 1918 and the earlier years, as annual records only are available for that period. The original data, showing the money value of retail and wholesale trade, are taken from the *Federal Reserve Bulletin* for 1919 and later years, and, before that date, are derived from statistics furnished to the National Bureau of Economic Research by a considerable number of representative firms, doing business in different sections of the United States.

The two curves in the lower right-hand corner of the chart (Figure 1), showing the physical production of goods ready for consumption, are plotted from statistics published by the Harvard Economic Service. The annual record for the earlier years, as shown in the smooth curve, has been derived from the unadjusted annual data for all manufactured commodities, published by the Harvard Economic Service. A straight-line trend, located by taking into consideration the figures furnished by the Harvard Economic Service for years back to 1899, has been eliminated, thus leaving only the cyclical oscillations. Several other trends were experimented with, but since none seemed more probable than the straight line, this was the one utilized.

An examination of the chart seems definitely to establish certain facts. It is clear, for example, that the amplitude of the fluctuations in the physical output of basic materials by factories generally exceeds the size of

the corresponding fluctuations in the volume of either wholesale or retail trade. Furthermore, it appears that the production of basic materials fluctuates more than does the production of goods ready for consumption, and that wholesale trade oscillates through a wider range than does retail trade. For example, we find that, in the latter part of 1919, the index of factory production of basic materials increased by about thirty-one points, while that representing production of goods ready for consumption increased by only nineteen points. During this same upward movement of the cycle, wholesale trade increased some thirty-one points, while retail trade moved up approximately fifteen points. These ratios are typical of most of the other cycle waves.

The striking thing brought out here is the relative stability of retail trade when seasonal changes are eliminated. This may be explained partially, perhaps, by the fact that most of us have certain customary wants which we satisfy at all times in so far as practicable; partially by the fact that the total income of the nation has, relatively, a narrow range of oscillation. It is evident, however, that the business cycle operates in the retail field just as truly as it does in the manufacturing field, and that the dates of the wave crests and troughs in the two fields are separated by only a few months. Presumably, the chief reason why the volume of retail trade increases during the boom of the manufacturing cycle is that, during this period, employment is very steady, and hence employees are in a better position to buy than at other times. It may be said that profits are also larger; but that this is a causal factor, is doubtful, since, in the larger concerns, profits are disbursed most liberally some months after factory production has begun to decline.

The chart seems also to show that, if the statistics

plotted are reliable, stocks of goods must be accumulated, during boom periods, to no small extent in factories, in retail houses, or in both. Otherwise, it seems impossible to explain the wide divergence between the large amplitude of the swings in basic material output, and the small amplitude of the changes in retail sales occurring in corresponding periods. As yet, we have too little direct information concerning the extent of these stocks to draw definite conclusions; but it appears probable that a study of their variability may explain some of the puzzling time-relationships existing between production and sales.

We now come to the task of analyzing the significance of the relationships shown by the chart among prices, trade, and production. If we confine our attention to the period between October, 1920, and December, 1923, it seems rather easy to work out a logical theory of the business cycle based upon psychical premises. It runs as follows: At the close of 1920, while stocks of goods on the retailers' shelves were still rather large, those in the hands of consumers began to be exhausted. Attracted by falling retail prices, consumers began to buy more freely, and hence retail sales rose. For several months, however, this added demand from the public was not passed along to the manufacturer; but, early in 1921, the diminution of retailers' stocks caused orders to filter through to manufacturers of finished goods. From that time on, the factories turning out these products became busier and busier. This increase in their activities necessarily resulted in a demand for basic materials, and hence, in the middle of 1921, we find the output of basic materials increasing. At first, the manufacturers were so anxious to get business that they offered their goods at even lower prices than before; but, early in 1922, their prices began to rise. Increasing optimism on the part of manufacturers

soon led to a boom which resulted in expanding credit and higher wages and manufacturing costs. This continued throughout 1922 and well into 1923, despite the fact that, in the latter part of 1922, retail sales began to fall off. At about the end of 1922, retailers were evidently purchasing vigorously for stock, for wholesale stores were still increasing their sales. Finally, about March, 1923, the retailers awoke to the fact that their goods were not being sold as rapidly as anticipated. They cut their purchases from wholesalers. The wholesalers reduced buying from manufacturers. The manufacturers could no longer market their entire output at prices high enough to cover the increased costs of production. Hence, the production of manufactured goods for consumption purposes began to decline. Eventually, this resulted in a decline in wholesale prices which was most marked in basic materials. Although the motivating force came from the lessened sales of the retailers, nevertheless retail prices did not decline as soon as wholesale prices. The reason is that the custom prevails among retailers of marking up each article a certain percentage above its cost price; and, when the demand falls off, they prefer to sell fewer goods at the regular margin above cost than to maintain their volume of sales by cutting their selling prices. The apparent paradox of the effect preceding the cause is cleared up when we see that the probable sequence of factors involved in a cyclical movement of business is:

(1) Retail trade.
(2) Wholesale trade.
(3) Factory production.
(4) Wholesale prices of raw materials.
(5) Wholesale prices of finished products.
(6) Retail prices of finished products.

Although the physical volume of retail trade moves first, the price of goods at retail appears as the last link of the chain.

On the face of it, this explanation of the sequence of events in the cyclical movement seems quite satisfactory. Unfortunately, however, it does not entirely solve the enigma. That much of the mystery still remains is forcefully brought out when we attempt to apply this line of reasoning to the cycle wave of 1919–20.

One of the first snags to interrupt our progress is this: Why did wholesale trade begin to decline in January, 1920, at the very time that retail trade was at its highest point, and retail stocks were increasing rather than diminishing? This may be answered by saying that, despite the fact that their sales were declining, wholesalers were still selling more goods than retailers, even though somewhat less than they had previously been selling. This view is supported by figures in the *Federal Reserve Bulletin* for November, 1923, page 1221, which show that the stocks of department stores kept on increasing until October, 1920. Because these figures are in dollars, and inventories are usually rendered in terms of cost, it is difficult to say whether or not the physical volume of retail stocks actually continued going up until October. But it is a significant fact that it was at about that period that the index of sales by wholesale stores began to move down close to the index of retail sales.

A still more puzzling problem is offered by the fact that, although the volume of sales by wholesale concerns did not begin to decline until February, 1920, the output of finished manufactured goods had been falling off since October, 1919. Why did factories lower their output, although wholesalers were still increasing their sales?

This may, perhaps, be explained on the hypothesis that wholesalers themselves became greatly overstocked early in 1919, and that their sales at the close of that year represented a passing on of this overload to the retailers, while, at the same time, they were cutting down their purchases from the manufacturers.

But still we are not at the end of our troubles. Both in 1919 and 1923, the figures show that production of basic materials reached its peak some two or three months after the production of finished commodities had attained its crest. What is the cause of this lag? Is it that the manufacturers of the finished products had placed orders with the makers of raw materials for their goods, and that the basic-material factories continued operations merely to fill these orders — from which it would follow that inventories of raw materials in the hands of manufacturers of finished products would necessarily increase during this period? Or was it, perhaps, that the manufacturers of basic materials, knowing that their products could be stored, still refused to believe that there was a serious fall in demand, and hence continued operations at full blast in the hope that business would soon revive, meanwhile accumulating inventories of the outputs of their own plants? Neither of these theories entirely lacks plausibility.

Now we come, however, to the most puzzling riddle of all. We see that the production of basic materials reached its peak in January, 1920, and by April had fallen sharply. There had already been a heavy decline in the production of finished goods as early as February, 1920. During April and May of 1920 there was, however, a sharp rise in the wholesale prices of finished, manufactured commodities. What brought about this rise? As we see, during these two months both wholesale and

retail sales were falling off rapidly. Factory production was also declining at an almost headlong rate. Why did prices continue to rise? Or perhaps we should turn the question around and inquire why, as long as the prices of finished products were increasing, did the manufacturers of those products lessen their output?

Is it true that manufacturers as well as retailers ignore the existing state of demand for their products and are so in the habit of charging for their goods a fixed margin above cost that they insist on higher prices even though they are able to market only a much smaller volume of goods? Was it this very insistence on selling goods at a safe margin above cost that forced them to curtail operations in February, 1920? Is optimism so affected by inertia that a rising demand for goods is continued by this force for a number of months after logical reasons for this optimism have disappeared? Ought we to look for the explanation of the rising prices of April and May, 1920, in monetary or banking conditions rather than in the fields of production and consumption? This seems hardly likely. Was the price rise dependent upon conditions of demand or of supply?

The problems just mentioned are among those that must be solved before the mechanism of the business cycle is really understood. Some of the difficulties involved may arise from faulty statistics; for, in 1919, the process of collecting this type of data was just getting established. Other difficulties may disappear when data become available for a longer period of years, thus making possible a more accurate elimination of the seasonal influence. The chances are that before long either the expansion of the statistical records themselves, or the development of better technique in handling the figures, will make possible a clearer understanding of the way the

economic cycle operates. It is hoped that the setting forth of some of the problems involved may serve to stimulate statisticians to test their mettle by attempting their solution.

CHAPTER III

FLUCTUATIONS IN RETAIL AND WHOLESALE TRADE

By W. RANDOLPH BURGESS

The usual review of business becomes indefinite at the point where it begins to discuss conditions in retail and wholesale trade. For production, for transportation, and for credit the argument is based on definite statistics, but the discussion of trade is usually to the effect that dealers say that trade has been dull or that trade reports indicate an excellent volume of trade. In the matter of trade statistics the student of business appears to be to a large extent in a nebulous stage, which has been superseded in most other aspects of business reported.

Indefiniteness in reporting trade conditions is the result, not of an absence of figures, but of difficulty in interpreting the figures which are available. In 1919, the Federal Reserve Banks, under the leadership of the Division of Analysis and Research of the Federal Reserve Board, began the collection from department stores and wholesale houses of figures showing the dollar value of monthly sales. At first, these figures were simply the percentages of increase or decrease which the sales in any month showed as compared with the sales in the corresponding month of the previous year. It was soon found, however, that these figures could not be relied on for accuracy, and that they failed to show the changes from month to month, which were of great interest. As a result the form of the reports was changed, with the cooperation of the reporting stores, to dollar figures which

could be converted into any type of index desired. The reporting system has been extended to include three hundred and thirty-three department stores in one hundred and seventeen cities, and twelve hundred wholesale

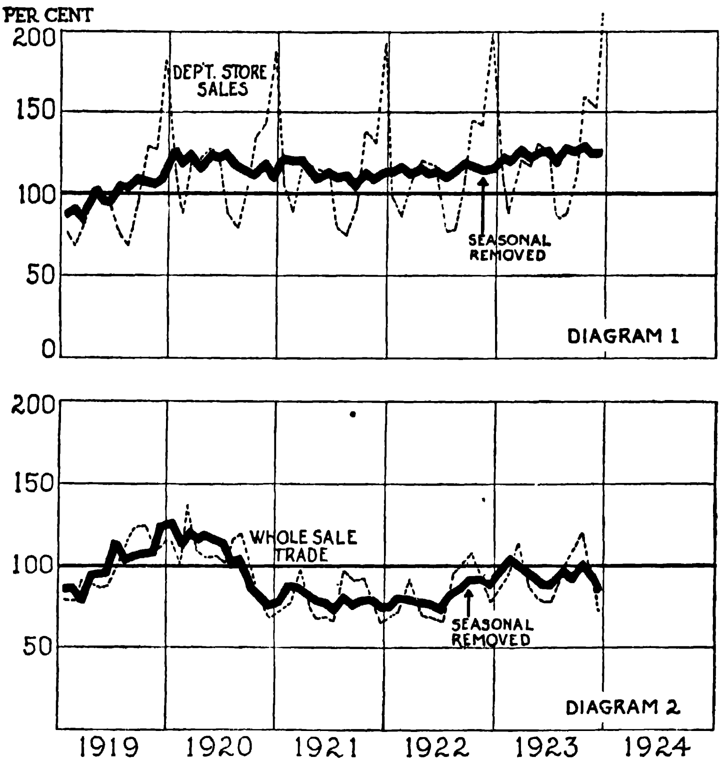


FIGURE 2. DEPARTMENT STORE SALES AND WHOLESALE TRADE, 1919–23

dealers in sixteen different lines, in all twelve of the Federal Reserve districts. The total sales of the reporting wholesale dealers amount each year to more than $2,000,000,000, and the sales of the department stores, to about $1,300,000,000. In most cases, reporting concerns have

been willing to furnish figures running back to the year 1919; and a continuous series of figures is now available for the period of five years. In addition to the figures for department stores and wholesale trade, there are now re-

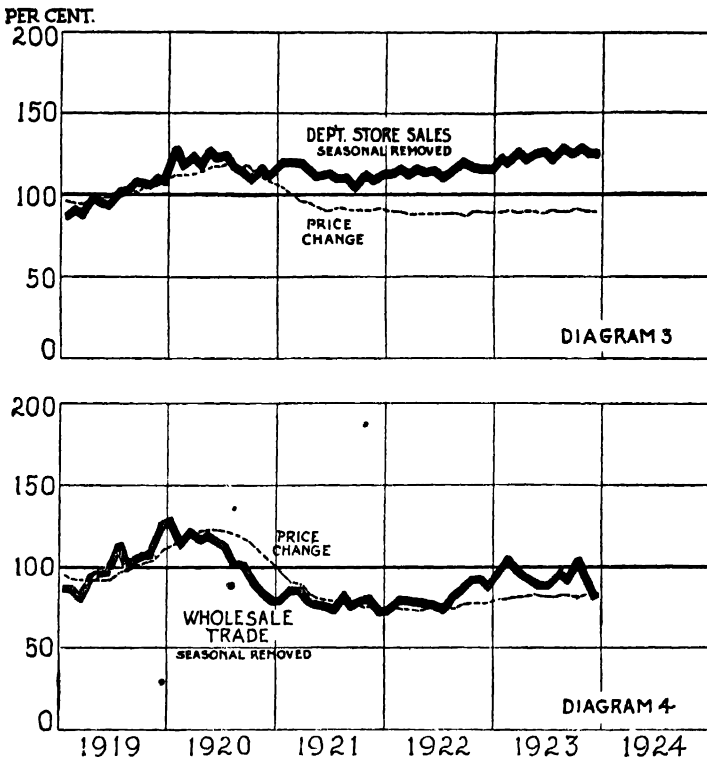


FIGURE 3. PRICE CHANGES COMPARED WITH CHANGES IN DEPARTMENT STORE SALES AND IN WHOLESALE TRADE, 1919–23

ceived data for sales of four mail-order houses, and of chain-store systems operating nearly twenty-five thousand stores.[1]

[1] For a further discussion of the data, see an article by L. H. Mann, of the Federal Reserve Board, *American Economic Review*, December, 1923, page

Although these figures cover so large a scope, they are not widely used by students of business conditions. The difficulty is that raw dollar figures for either wholesale or retail trade do not answer the questions which the

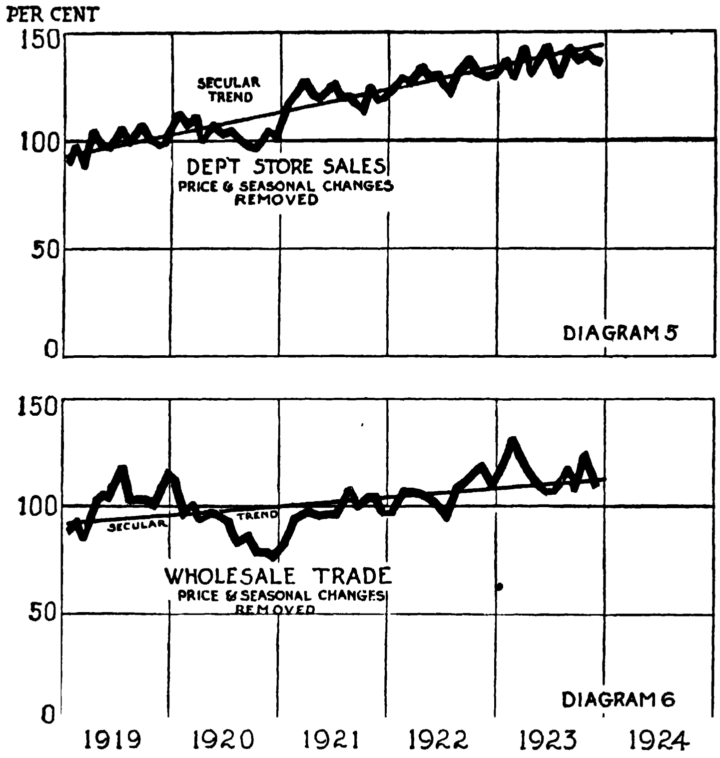


FIGURE 4. SECULAR TREND OF DEPARTMENT STORE SALES AND WHOLESALE TRADE, 1919–23

student of business conditions asks. He always wants to know whether trade is going up or down, whether it is better or worse. The difficulty with trade data is that the

609; and articles on page 17 of the *Federal Reserve Bulletin* for January, 1924, and on page 439 of the *Federal Reserve Bulletin* for April, 1923.

figure for any month is the result of a number of other factors besides the month-to-month change in the demand for goods. The demand for goods is concealed behind a matrix of other influences. In the first place, there is a

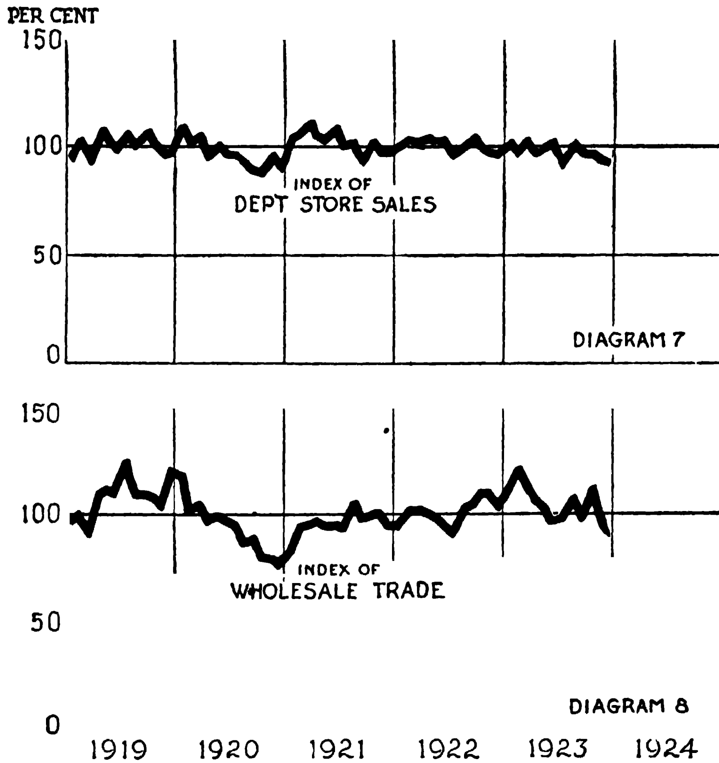


FIGURE 5. INDEXES OF DEPARTMENT STORE SALES AND WHOLESALE TRADE IN PERCENTAGE OF COMPUTED TREND, 1919–23

(Allowance made for seasonal and price changes.)

tremendous seasonal variation, so that, in the case of department-store trade, sales in December of each year are characteristically more than twice as large as sales in February or August. In the second place, the dollar

amount of sales is powerfully affected by changes in prices of the goods sold. In the third place, there is a natural growth in sales, from year to year, which tends to give a constant upward trend of sales, almost regardless of business conditions. These same factors are apparent, in somewhat lesser degree, in wholesale trade. Before there can be understanding of the significance of any month's figures, allowance must be made for these various distorting factors.

The Reports Department of the Federal Reserve Bank of New York has recently been preparing indexes of retail and wholesale trade in the Second Federal Reserve District, in which allowance might be made statistically for these various influences, and a figure secured which should indicate, on inspection, the changes in the demand for goods as they are reflected in wholesale and retail trade.[1]

The various steps in the preparation of these index numbers are shown in the diagrams. Diagrams 1 and 2 show the raw dollar statistics as they are reported by department stores and wholesale houses in the Second Federal Reserve District, but converted into the form of percentages of average monthly sales in the year 1919; the diagrams also show the statistics after an allowance has been made for seasonal changes.

Diagrams 3 and 4 compare with the seasonalized lines of Diagrams 1 and 2, an index of price changes in wholesale and retail trade, and Diagrams 5 and 6 show the seasonalized sales after they have been divided by these price indexes.

Diagrams 5 and 6 also show the computed trend lines

[1] This work is part of a larger study undertaken to secure an index of the total volume of trade. The project is described in an article by Carl Snyder in the December, 1923, *Quarterly Publication of the American Statistical Association.*

for year-to-year growth; and in Diagrams 7 and 8 sales figures are shown as percentages of the computed trend lines, or in percentages of computed normal. These final diagrams show the times when the demand for goods has been large and when it has been small. They reflect the changes in retail and wholesale trade, independent of seasonal influences, price changes and year-to-year growth, in so far as the methods used make that possible.

The methods by which allowance for seasonal variations and allowance for year-to-year growth or trend have been made are those familiar to students of present-day statistics. The index of seasonal variation used for this brief span of years has been the median percentage deviation from the annual average. The lines of secular trend are straight lines computed by the method of least squares. The period of years for which data are available is so limited that the results are subject to considerable modification as more data become available. The seasonal variation is so regular that the scatter of the seasonals is narrow and the margin of error in this connection probably small. It is in the line of secular trend that there is probably most room for error.

Making allowance for price changes is more difficult and requires more detailed exposition. There are no available price indexes precisely designed to measure price fluctuations in wholesale and retail trade, and more specifically in those lines of wholesale and retail trade which are represented in the Federal Reserve Bank statistics. In order to secure indexes which might reasonably be used, a series of experiments with the available statistics has been undertaken.

The first step was to search for indexes which would correspond most nearly with the trade figures. An approach to a reasonable wholesale index was secured by

combining a number of the group indexes of the Bureau of Labor Statistics. The following table shows the groups used and the weights assigned to each group, as compared with the relative weights of different lines of trade in the wholesale trade index:

TABLE 4

(Department of Labor Wholesale Groups)

Weights in Wholesale Trade Index			Weights Used in Price Corrector	
Groceries		37	Food	37
Cloths and clothing				
Dry goods — cotton	10			
silk	10			
Men's clothing	10	45	Cloths and clothing	45
Women's suits and coats	8			
Women's dresses	7			
Shoes		7		
Drugs		3	Chemicals and drugs	3
Hardware		3	Metals and metal products	4
Stationery		2	House furnishings	3
Jewelry		1		
Diamond		1	Miscellaneous	8
Machine tools		1		
Total		100	Total	100

It is clear that the price index thus prepared is roughly representative of the prices in the wholesale trade groups. In order to test the value of this index, the wholesale trade index, seasonalized, was divided by the price index so prepared. The result was clearly unreasonable, as it showed wholesale trade at its highest point in the midst of the depression of early 1921. This result led to a more careful inspection of the price figures and to the conclusion that the group indexes of the Department of Labor were not representative of wholesale trade prices because they were too heavily weighted with raw materials. In the cloths and clothing group, for example, which is the most important single group, it was found that sixty per cent of the total weight was in yardage goods, and only forty per

cent of the weight, in garments and other products at the ready-to-wear stage. On the other hand, the wholesale trade figures, which might be grouped as cloths and clothing, were almost altogether for finished garments. The trade figures represented more labor and more overhead than the goods represented in the price index. Because garments are not standardized, it is practically impossible to secure a continuous price index which would apply directly to the clothing groups represented in the wholesale trade index. Exactly the same qualification applies to other price groups used. In order, therefore, to secure an approximate index, the price figures shown above were supplemented by an index of wages, made from the New York State Department of Labor reports of the average earnings of factory workers. Wages were given a weight of 1 in the total of 6, and the resulting index is that shown in Diagram 4.

The best test of the validity of this price index as representing wholesale trade is to be found in the reasonableness of the final index of the volume of wholesale trade. This was tested in two ways. In the first place, the index, with the various problems of its make-up, was presented to wholesale dealers who had been coöperating with the Bank in furnishing statistics and were generally intelligent as to the tonnages of goods moved at different periods. The second test was found in the comparison of the final index with similarly prepared indexes for carloadings, retail trade, and bank debits in New York City corrected for price changes and seasonal variation. These three comparisons are shown in Diagrams 9 to 11. They all give results which are essentially reasonable. Wholesale trade shows a wider swing than retail trade, but the movements are timed not far apart. Wholesale trade shows a close relationship with carloadings and merchandise and

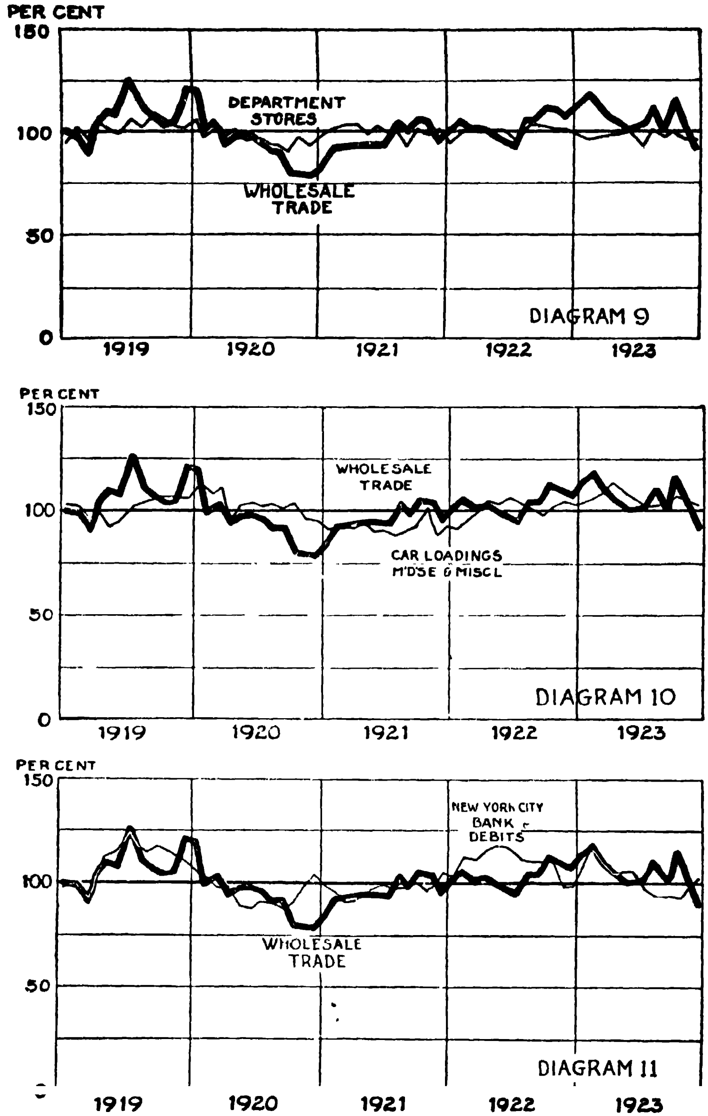


FIGURE 6. WHOLESALE TRADE INDEX COMPARED WITH VARIOUS OTHER TRADE INDEXES, ALL IN PERCENTAGE OF COMPUTED TREND, 1919–23

miscellaneous freight, but shows a tendency to precede such loadings, as would be expected, since trade figures represent, in part, orders for future delivery. Wholesale trade shows a close correspondence with the general movement of New York City debits. The conclusion has been drawn, from this evidence, that we have, in the final index of wholesale trade, a close first approximation of the actual movement of goods at wholesale in response to demand.

Similar methods were employed in securing a satisfactory index to represent price changes in retail trade, although the field from which to select indexes was considerably narrower. The only retail price indexes readily and generally available are the index of retail prices of food, prepared by the United States Bureau of Labor Statistics, and several indexes of the cost of living divided into their various elements. It was first thought that the trend of prices of department-store trade would be represented most nearly by the sub-groups on prices of clothing, furnishings, and miscellaneous articles in the various cost-of-living index numbers; but the test of experiment, as in the case of wholesale trade, did not yield reasonable results. A further study revealed a number of other price indexes which might be compared with cost-of-living figures. A group of chain shoe stores reported the number of pairs of shoes sold, as well as the dollar value of sales; and from these figures it was possible to compute an index of changes in the average price per pair. There was also obtained, from one of the chain grocery stores, an index showing the price changes in their most important commodities; and, for a number of the largest department stores, statistics were secured showing the average value of each sales transaction, a figure affected by many causes, but most largely by price

changes. A number of these indexes are shown in Figure 7. They indicate that the index compiled from two elements in the cost of living has a much wider swing than the actual price changes involved in retail transactions. In fact, the total cost-of-living index number, which includes rent and prices of food and fuel, as well as clothing and

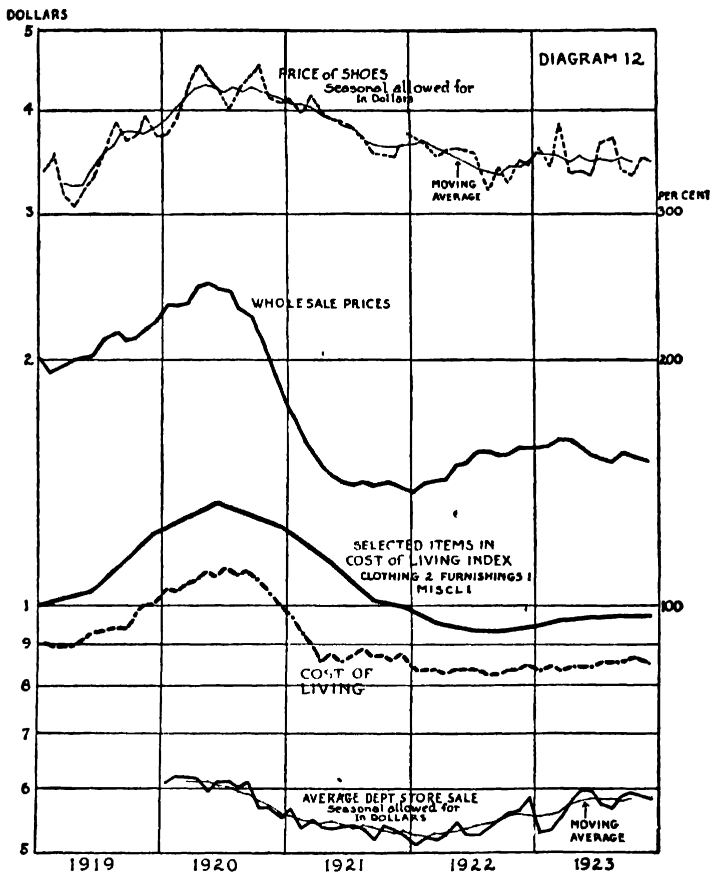


FIGURE 7. RETAIL PRICES COMPARED WITH WHOLESALE PRICES, 1919–23
(United States Department of Labor Index.)

miscellaneous items, seems to represent much more nearly the changes in prices which actually occur in retail trade transactions, such as are characteristic of department stores.

There are a number of factors which slow down price changes in retail trade. There is tremendous public resistance to price changes and there is always a tendency to substitute a different grade of article rather than to advance prices heavily.[1] Another factor is that, for considerable amounts of the goods sold in department stores, stock is turned over only every six months or a year, and the prices of these goods tend to change much more slowly than the prices of the more rapid turnover, standardized articles which are of necessity used as the basis for most price indexes. The element of wages paid to employees is also a stabilizing factor in the prices of goods sold.

As a result of these considerations, it was decided to experiment with the use of the total cost-of-living index number, computed from the figures of the United States Bureau of Labor Statistics and the Massachusetts Commission on the Necessaries of Life. An index which is a combination of the figures from these two sources is presented in Diagram 3 and has been used throughout. Here, again, the chief test of the results, beyond the

[1] This discussion involves the whole question of the necessity for using identical articles continuously in preparing a price index. In this particular case it becomes clear, however, that an index computed from the prices of identical articles would fluctuate more widely than an index of the value per ton or per pound of the goods sold, which is close to what we want in an index of the volume of trade. The fact is that some of the identical articles would not be purchased in quantity as their prices became unreasonably high. What we need but cannot secure is the "ideal index number." What has happened, moreover, is not simply a change in the relative weight of different transactions, but an actual substitution of items. The only way out of the dilemma appears to be a rather arbitrary insertion in our index of elements the prices of which change very slowly, such as rent.

logical considerations which have been listed, is their reasonableness. The general movement of the line appears to be reasonable in indicating a heavy volume of trade in the latter part of 1919 and the early part of 1920, less trade in 1920, a recovery in 1921, and the maintenance of a moderate volume of trade throughout the following two years. A comparison already made between wholesale

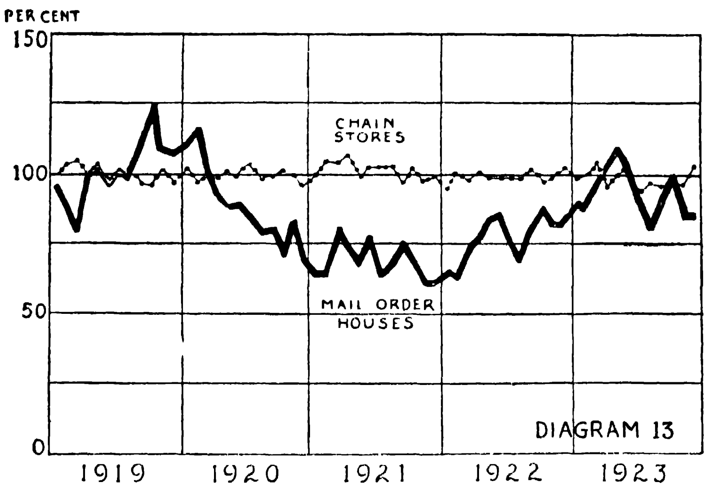


FIGURE 8. SALES OF CHAIN STORES AND MAIL ORDER HOUSES IN PERCENTAGE OF COMPUTED TREND, 1919–23
(Allowance made for seasonal and price changes.)

and retail trade indicates a reasonable degree of correspondence. In general, the retail trade line shows a steady volume of purchasing, with little interruption due to changing business conditions, which is thoroughly in keeping with the fact that retail trade deals directly with the consumer whose needs for clothing and other articles are only moderately affected by changes in business. A further test of the price index as a corrector is found in its use in the case of chain-store sales and sales

of mail-order houses, the results being as indicated in Diagram 13 (Figure 8).

In the case of chain stores, the fluctuations in the price corrector have been reduced by one half, because of the fact that in the chain stores the heaviest weight is on sales of five- and ten-cent stores, where prices are subject to much less fluctuation, the fluctuation taking place instead almost altogether in the character of the goods sold. With mail-order sales, the cost-of-living index is used in the same fashion as with department-store sales; and, again, the result is in reasonable concurrence with what we know of rural conditions during the period.

These computations give us a first approximation to a measure of the physical volume of wholesale and retail trade. They are admittedly subject to modification, as further experience accumulates. In particular, there may well be modifications in secular trend and in the correction for price changes. It is my belief that future modifications will not materially alter the general movement of the indexes, and that they give, in their present form, a much more satisfactory interpretation of trade statistics than can be made directly from the raw dollar statistics by even the best-qualified student.

CHAPTER IV

FLUCTUATIONS IN PRICE-LEVELS

By IRVING FISHER

ELSEWHERE,[1] I have shown that a chief determinant of the business cycle is the *rate of change* of the price-level, or, reciprocally, of the purchasing power of the dollar. A curve (P'), representing this *rate of change* of the index number (P) of wholesale prices of the United States Bureau of Labor Statistics, was found to be highly correlated with the curve (T) of the American Telephone and Telegraph Company, representing the physical volume of trade. This trade curve (T) lags behind P'; but, if P' is pushed forward three months and then smoothed by a moving average ("trailing" through eight months, with weights 8, 7, 6, 5, 4, 3, 2, 1), this smoothed curve ($\overline{P'}$) is found to be correlated with T, for the period 1914–22, to the extent of 79 per cent. The above smoothing process is equivalent to assuming that the influence of any given "rate of change" (P') is distributed over the future, beginning in three months and tapering off in successive months, in proportion to the numbers 8, 7, 6, 5, 4, 3, 2, 1.

A closer correspondence is obtained if, instead of assuming the distribution of effect to follow the last-named evenly descending series, we assume a series (0–2–6–11–18–23–25–23–18–12–7–4–2–1), representing a type of the frequency or probability distribution, and if, instead of the Telephone and Telegraph Company's T

[1] The present paper is merely a report of progress on the study outlined in the *Quarterly Publication of the American Statistical Association*, December, 1923.

curve, we take the *T* curve recently constructed by the Harvard Committee on Economic Research.

With these two changes, I find the correlation between the new $\overline{P}'$ and the new *T*, for the period 1915–22, to be 86 per cent, while for the period 1919–22, it is 93 per cent and for the period 1920–22, 94.4 per cent.

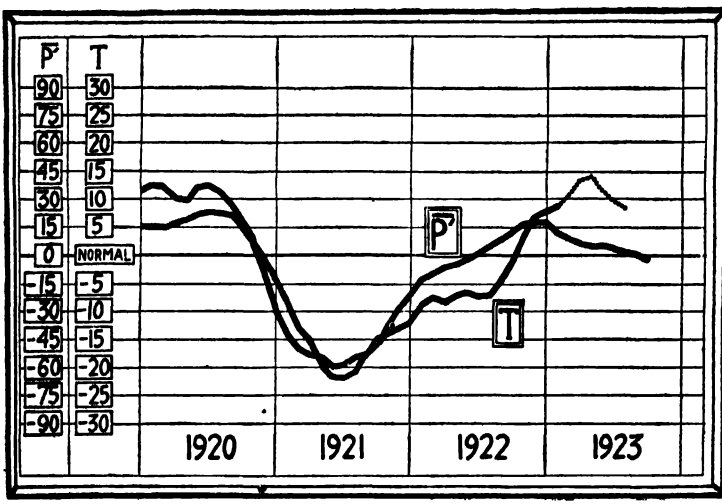


FIGURE 9. RATE OF CHANGE IN THE PRICE LEVEL COMPARED WITH VOLUME OF TRADE, 1920–23

"The curve P′ shows the *rate of change* in the price-level, "smoothed" and projected ahead about seven months. Thus, at the start, the curve is 35 points above the zero line, indicating a rate of increase of prices seven months previously of 35 per cent per annum. The curve T represents the physical volume of trade as measured by the Harvard Committee on Economic Research, corrected for secular trend and seasonal variations and with the employment item omitted. The beaded part, at the end, is the American Telephone and Telegraph Company's trade curve, added in order to carry the figures more nearly down to date.

These figures are, so far as I know, the highest of any yet found between business and business forecasters. The extremely high correlation (94.4 per cent) for the period 1920–22 is shown in Figure 9. This shows that by this forecaster it would have been possible, months in advance,

to have foretold almost exactly the course of the recent depression of trade and the recovery therefrom.

The above results are the best thus far found from numerous trials, both as to lag and distribution of influence. They are not final, and I am still engaged, with the help of the Standard Statistics Company, in working through laborious calculations, in the hope of finding an even closer correspondence, when the most appropriate type of distribution-of-influence is found, as well also as the best index (T) of the volume of trade. When this analysis of the influence of price change is complete, it may be possible to make a synthesis with other influences, besides the one here considered, that of the purchasing power of the dollar.

CHAPTER V

FORECASTING RAILWAY TRAFFIC

By R. H. AISHTON

RAILWAY freight traffic is a composite of the business activities of all other industries. To arrive at a forecast of freight traffic one must survey the whole business field. Forecasting by any other industry depends only on the factors that have a bearing on the particular industry involved, whereas the railways must take into account all the problems that are faced by all the industries that utilize their facilities, which means all the industries of the nation. That is the hard part of it.

The other side of the question is that the problem is simplified by the very fact that railway freight traffic is a composite — a cross-section, if you please — of all industrial activities. A single industry, in forecasting the future, may easily go wrong by placing its estimate too high or too low. When a large number of industries are combined, however, the law of averages will overcome, in some degree, the over- or underestimating of individual industries.

Three principal factors must be considered in making any forecast of railway traffic growth. The first factor is the growth of population. The increase between 1910 and 1920 was about fourteen per cent. During the first twenty years of the present century, the increase was nearly forty per cent.

The second factor is increased use of railway facilities per capita; that is, the increase in number of ton-miles per inhabitant per year, and of passenger-miles per inhabitant

per year. It is difficult to appreciate, unless one looks into the matter in detail, how rapidly the per capita utilization of our railway facilities has increased during recent years. For example, between 1900 and 1920 the number of ton-miles per capita increased more than one hundred and ten per cent. As there was an increase of forty per cent in population during the same period, the cumulative result of an increase of forty per cent in number of persons and an increase of one hundred and ten per cent in the use of the railways by each person, was an increase of two hundred per cent in the total demand for transportation.

The third factor is the continual change in character and composition of railway freight traffic. The average distance a ton of freight is hauled has been gradually increasing during the past thirty years, and is now higher than ever before. The several commodities and groups of commodities making up the aggregate of railway freight have also shown marked changes in recent years. It is clear that both factors play a considerable part in volume of freight traffic and in number of tons carried one mile. The volume is affected by the shift from heavy, low-grade commodities to light, high-grade commodities, or *vice versa*. The number of ton-miles is similarly affected, not only by the volume of freight, but also by the average distance it is hauled.

The railways have recently completed an interesting experiment in traffic forecasting. In order to provide adequate transportation during 1923, it was first necessary to have some measure of what the business was going to be, as the basis of a tentative or working estimate of the probable volume of freight traffic that would be offered the railways. The Car Service Division of the American Railway Association made such

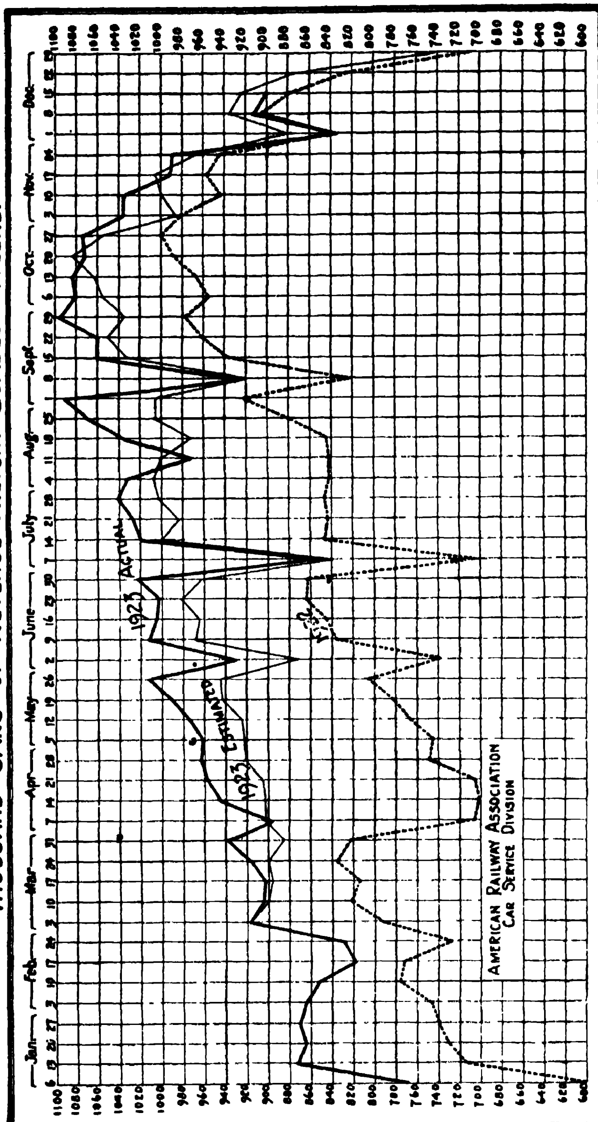


FIGURE 10. REVENUE FREIGHT CAR LOADINGS OF 1922 COMPARED WITH 1923 AND ESTIMATE FOR 1923

an estimate using not only the known factors that I have referred to, but also the loadings already handled during the first two months of the year 1923. Comparing that record with the corresponding periods of the years 1918–22, we estimated the probable number of cars to be loaded in every week of the year 1923, from March to December. The light line on Figure 10 indicates the expected loading in cars of revenue freight per week. The heavy line gives the actual loadings week by week from March first. The two lines are very close together.

The largest number of freight cars loaded in any week prior to 1923 had been 1,018,000, which occurred in the month of October, 1920. Only five times prior to 1923 had the railways loaded more than a million cars in any week. One of our problems was to estimate what the peak loading of 1923 would be. From the computation outlined above, it appeared that the peak week this year would be well in excess of 1,100,000 cars. This prospect was so greatly in excess of past experience that, in order to be safe, we reduced it to 1,080,000. That our estimate was conservative is indicated by the fact that our peak loading this year was slightly in excess of 1,097,000 cars — within less than three thousand cars of our original estimate of 1,100,000, or within three tenths of one per cent. In addition, beginning with the first of June and continuing down to the second week of November, the railways loaded more than a million cars each successive week, with only three exceptions, those exceptions being the two holiday weeks in July and September, and the week in August during which occurred the funeral of President Harding. In all, there were twenty-one weeks in 1923 in which more than a million cars were loaded. During nine consecutive months, the loadings averaged more than a million cars weekly — a remarkable record in itself.

After some study of the problem, I am inclined to think that the first three months of the year furnish a fairly good measure of what the traffic of the year as a whole is likely to be. Taking the carloadings of the five years 1918–22, I find that the average ratio of the loadings of the first three months to the total annual loadings was 22.66 per cent. That is, the railways in those five years handled between twenty-two and twenty-three per cent of their total freight business during the first quarter. Variations from this percentage in the several years are remarkably small, when we consider that the year 1918 was a war year, that the year 1919 was a period of recession in business, that the year 1920 was marked by feverish business activity and inflation, that the year 1921 was one of deep depression, and that the year 1922 showed only partial recovery. In other words, none of these five years can be regarded as a normal business year; yet the highest percentage shown by the first quarter of any of them was 23.55 per cent, and the lowest 21.84 per cent, compared with the five-year average of 22.66 per cent. The range from low to high was less than two per cent, and the maximum variation from the average was less than one per cent. If this experience over the period of five years for which weekly carloading statistics are available supplies any basis for a method of forecasting, it will be possible in any year, about the first of April, to estimate the probable traffic for the remainder of the year.

Such a forecast must always be made with the fact in mind that unforeseen occurrences, such as prolonged industrial strikes, coal strikes, railway strikes, or foreign disturbances, may occur at any time to upset the estimate. Our presidential election every fourth year is also a disturbing element. Crop possibilities can never be

accurately forecast. Seasonal variations in traffic cannot be accurately measured beforehand. Whether we shall ever again make a guess within three tenths of one per cent of the peak traffic carried in any one year and within three per cent of total traffic carried, as we did in 1923, remains to be seen.

DISCUSSION BY JULIUS H. PARMELEE

In view of the unprecedented freight traffic handled by the railways this year, the fact that the estimate made by the American Railway Association last March was sustained by the actual traffic of the year within a margin of error of three per cent is nothing short of remarkable. This was not a fortuitous result, for the actual loadings paralleled the estimates within a fairly close range week after week through the year. In comparing the estimated with the actual traffic of the four weeks of November and the first two weeks of December, for example, I find that the margin of error was only nine tenths of one per cent. This indicates that the estimate for the year was not a haphazard one, but was the result of an intelligent statistical computation.

This leads me to comment on one outstanding feature of this matter of forecasting railway traffic; namely, its seasonal character. Mr. Aishton has referrred to this phase of the subject, and has expressed the opinion that with the actual results for the first two or three months of any year in hand, the traffic of the remaining months can be plotted with a fair degree of accuracy. Barring such interruptions to the seasonal swing as may be caused by coal strikes, railway strikes, or other serious disturbances, any portion of a year's traffic will apparently furnish a clue to the remainder. The future experience of the American Railway Association with this method of fore-

casting, on the basis of seasonal movements of traffic, will be awaited with great interest.

That railway traffic is seasonal to a marked degree is clear to any one who studies the record of carloadings during recent years. Every year shows a very wide spread between the high week and the low week; that is, between the peak and the valley. Omitting the weeks that are affected by the occurrence of a national holiday, the spread between high and low in each of the last five years has been as follows, stated in terms of the percentage by which the high week was greater than the low week: 1919, 47.4; 1920, 69.3; 1921, 44.7; 1922, 42.9; 1923, 34.1. The average of the valleys for the five years was 692,000 cars, while the average peak was 1,015,000 cars. Thus the average high was greater than the average low by 323,000 cars, or nearly fifty per cent.

The question arises whether this violent fluctuation in seasonal loadings could not be avoided, if some of the industries whose shipments are now seasonal endeavored to distribute their shipments more evenly throughout the year. This subject has too many ramifications to be more than suggested in this brief discussion, but it is worth noting that two efforts were made this year in the direction of a more even distribution of traffic, and that both efforts were reasonably successful. In the first place, the railways themselves moved the coal needed for their own use earlier than usual, so as to get that traffic out of the way of the heavy commercial movement during the fall. Thus, in December, they had a larger amount of fuel coal in storage than ever before. The result was to shift a part of the railroad coal traffic to earlier months, and to spread out the total year's movement to that extent.

The second example was the voluntary effort made by the cement industry to reverse the usual proportion of

their shipments as between the first and second half of 1923. Instead of shipping forty per cent of the total before July 1 and sixty per cent after that date, they shipped approximately sixty per cent before and forty per cent after. This was done to enable the railways to handle their traffic more evenly throughout the year, for the bulk of the crop movements must necessarily be concentrated in the second half of the year, and any other traffic that can be shifted from the second half to the first half relieves the pressure of traffic at a time when it is most needed.

These are but instances. There may be others, and there should be many more. This element may properly be regarded as a part of the problem of stabilization. If railway traffic could be more evenly distributed, it would not only simplify the problem of forecasting, but would have much wider benefits as well, for it would result in a better balanced and therefore more efficient transportation service, more even employment on the railways, and a helpful reaction on the general stabilization of industry.

CHAPTER VI

FLUCTUATIONS IN RAILWAY TRAFFIC

BY DAVID FRIDAY AND L. E. PEABODY

THE volume of transportation depends upon the volume of commodity production within the country and the way in which that production is geographically distributed and diversified. The unit which is most valuable for measuring transportation, when comparing the number of times commodities are retransported, is the number of tons originating. Its defect is that it takes no account of distance, and distance carried is of the essence of the transportation service rendered. Revenue ton-miles is the unit which expresses both the weight of the total tonnage carried and the average distance transported. In surveying the general growth of the transportation function in modern industrial society, the revenue ton-mile is used as the unit of transportation.

The period chosen for study here is that from 1890 to 1922. Figures showing the increase in revenue ton-miles are available throughout this period. It is impossible, however, to get any index of production that dates back to 1890. Therefore, the studies which attempt to compare the growth in production with the growth in transportation services of the various classes of commodities, such as agricultural products, the products of mines, and manufactured goods, must begin with 1900. We have used for this purpose the production index of Edmund E. Day, which begins with 1900.

By 1890 the railroad system of the United States had begun to assume its present character as a nation-wide

transportation system, supplying all parts of the country with railroad facilities. It had expanded from 52,922 miles of road in 1870 to 93,267 in 1880; and, again, to 163,597 in 1890. There were still many portions of the country which were a considerable distance from the railroads, and the twenty years between 1890 and 1910 saw an extension of branch lines for the convenience of these communities. But the system as it stood in 1890 was a national system. It makes, therefore, a logical starting-point for the analysis of variations in railway traffic.

Traffic on the railways of the United States, measured in revenue ton-miles and revenue passenger-miles, has shown a remarkable increase since 1890. Revenue ton-miles have increased from 76.2 billion in 1890 to approximately 420 billion in 1923. Revenue passenger-miles during that period of time have increased from 11.8 billion to about forty billion. Figure 11 shows that the climb was steady and with very few decreases until 1914. After that year, both freight and passenger traffic are more irregular in their movements.

Ton-miles increased at a somewhat faster rate than passenger-miles, both relatively and absolutely. The trends, obtained by the least-square method, for the two kinds of traffic are:

Ton-miles	$y = 5.405t + 223.288$
Passenger-miles	$y = 0.535t + 26.494$

where y is the ordinate of ton-miles or passenger-miles (in billions) and t is time. The unit of time is the half-year, with the origin halfway between 1906 and 1907. Ton-miles per capita are very nearly linear, and it seems reasonable to expect them to continue so. Passenger-miles per capita are not so stable in their increase as ton-miles per capita.

The traffic for the period from 1890 to 1916 is given in

the reports of the Interstate Commerce Commission on the basis of the fiscal year ending June 30th. These

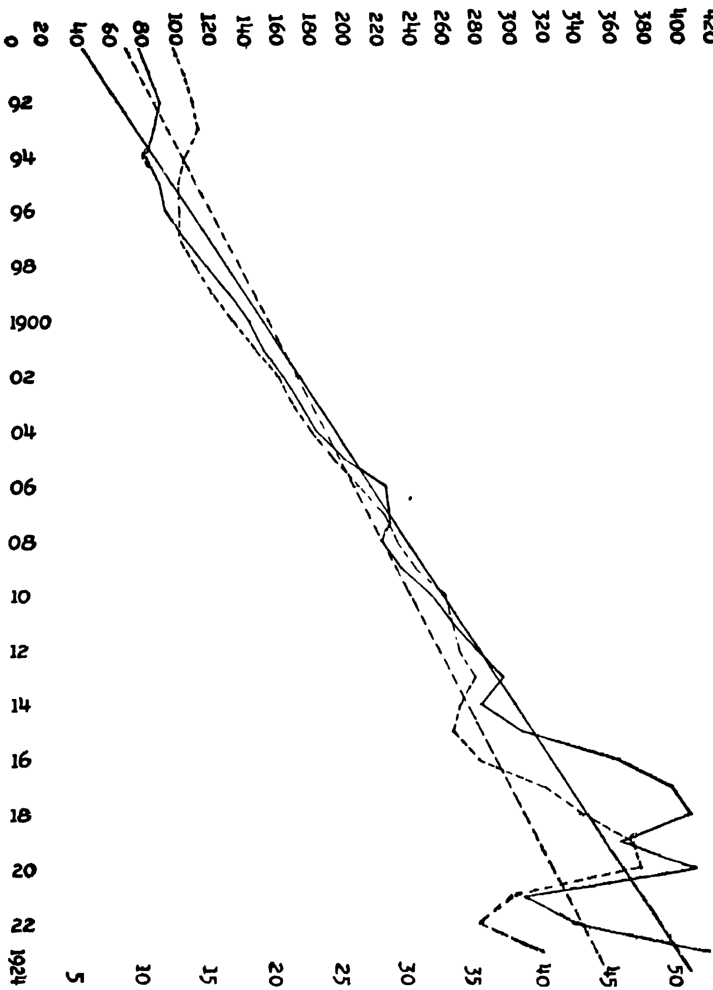


FIGURE 11. REVENUE TON-MILES COMPARED WITH REVENUE PASSENGER-MILES, WITH COMPUTED TRENDS, 1890–1923

Revenue Ton-Miles ——; Revenue Passenger-Miles - - -

figures have been put on a calendar-year basis by the use of the seasonal variations of freight and passenger traffic. These seasonal variations show that 47.2 per cent of the freight traffic and 47.3 per cent of the passenger traffic is moved in the months from January to June, inclusive, and that 52.8 per cent of the freight traffic and 52.7 per cent of the passenger traffic is moved in the months from July to December, inclusive. It is then a simple matter to combine these amounts and get the traffic on the calendar-year basis. Since 1916 the reports of the Commission use the calendar instead of the fiscal year.

Freight business reaches its first peak in 1892; passenger business, in the following year. Both fall slightly after this, and then unbroken climb to a double peak in 1913. Ton-miles fall to a low point in 1914, and passenger-miles, in 1915. After the lows in 1914 and 1915, both ton-miles and passenger-miles advance more rapidly than in any other part of their path, due to war activities. Ton-miles are at a peak of 409 billion in 1918, drop to 367 billion in 1919, and rise to 414 billion in 1920. Passenger-miles climb steadily to a peak of 47 billion in 1920. Both then fall very sharply, ton-miles to a low in 1921 and passenger-miles to a low in the following year. Both rise again during 1923 and establish a new high of 420 billion for ton-miles. It is significant that passenger-miles for 1923 are close to the figure for 1917.

Cyclical Variations

If the ordinate of secular trend is calculated for each year from the equations given above, the difference between that ordinate and the actual figures for a given year will measure the deviation from the "normal," or expected figure. The ratio of that deviation to the ordinate of trend will give the percentage deviation of the

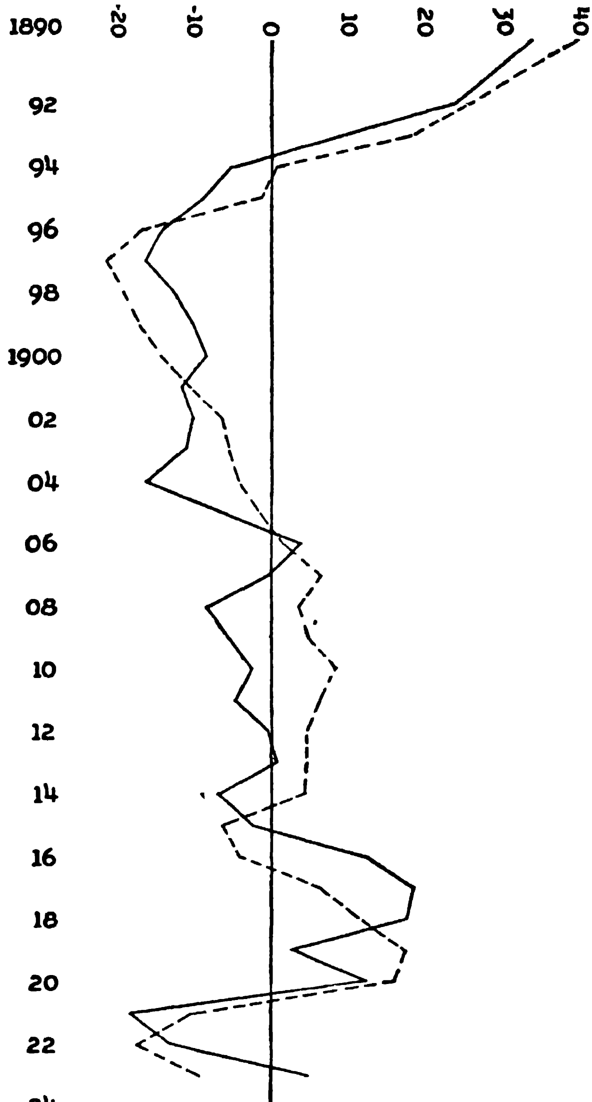


FIGURE 12. REVENUE TON-MILES AND PASSENGER-MILES IN PERCENTAGE DEVIATION OF THE ACTUAL FROM THE COMPUTED NORMAL, 1890–1923

Revenue Ton-Miles ——; Revenue Passenger-Miles - - -

actual from the expected figures for any given year. These percentage deviations for both freight and passenger traffic have been made for the years from 1890 to 1923 and are presented in Figure 12. The two cycle curves move together fairly closely, except during the years from 1907 to 1914. During that time passenger traffic was well above normal, while freight traffic was about equally below it. There is a noticeable similarity in the movements of the two kinds of traffic and, as in the two curves previously considered, a lag of a year or two in the highs and lows between freight and passenger traffic. Both freight and passenger traffic cross the normal line at about 1894. In 1897 freight reaches the low point of 13.7 per cent and passenger traffic, 21.4 per cent. Passenger traffic goes to a high of 8.3 per cent above normal in 1910, drops to a low of 6.2 per cent below normal in 1915, and then rises 17.3 per cent above normal in 1919. Ton-miles are 18.3 per cent above normal in 1917 and 18.6 per cent below in 1921.

Character of Traffic

Since 1899, the reports of the Interstate Commerce Commission have classified freight traffic as follows: products of mines, manufactured products and miscellaneous, products of agriculture, products of forests, less-than-carload (called merchandise in the earlier reports), and products of animals. The thirty-fifth Annual Report of the Commission gives the tons originating on all roads of the United States for 1899 and subsequent years. In the earlier reports to the Commission, some roads failed to classify their tonnage: some failed to report the tonnage at all. In the later reports, some of the tonnage is classified as "unassigned." It was thought advisable, therefore, to take the tonnage originating as

given in the thirty-fifth Annual Report, and to classify it by means of the percentages of each class obtained from the reporting roads. The number of reporting roads is

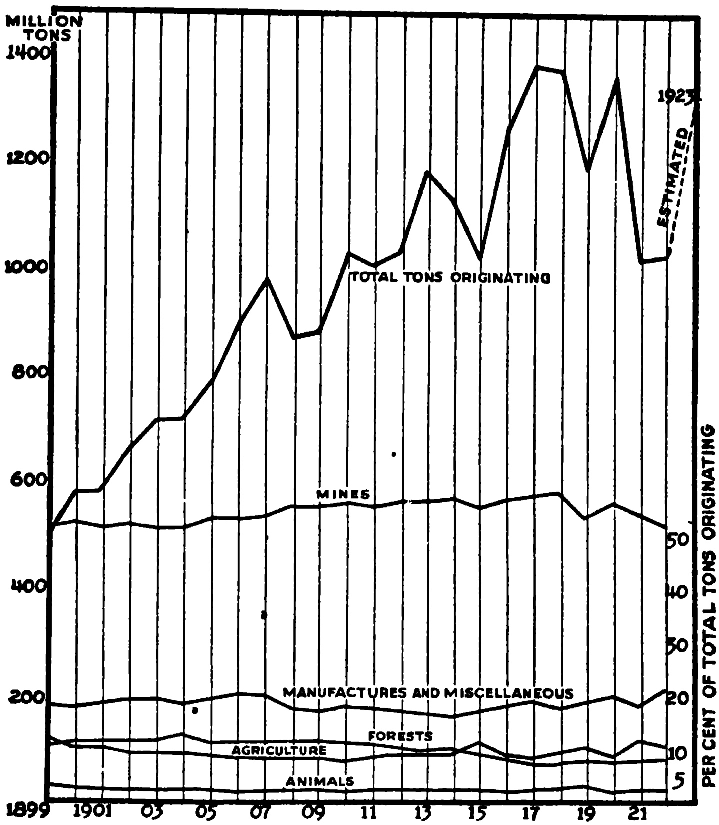


FIGURE 13. RAILROAD TONNAGE OF VARIOUS PRODUCTS, 1899–1921

considerably over eighty per cent of the total in every year; so the errors will be small.

Tonnage originating has increased steadily from 502 million in 1899 to 1382 million in 1918, the year in which

the greatest tonnage was moved. The following year, 1919, was nearly as great, with 1377 million; but, in 1921, the tonnage originating dropped to 1018 million, and, in 1922, to 1023 million, which is almost exactly the 1915 figure of 1024 million.

The number of passengers carried varies as follows (unit — one million): 1890, 492.4; 1914, 1063.2; 1915, 985.7; 1920, 1269.9; 1921, 1061.1. The gains in number of passengers carried prior to 1911 were much greater than during the succeeding period.

One of the most striking features of freight traffic is the remarkable constancy of the ratios of the different classes to the total tonnage. (See Figure 13.) It is easy to understand why more products of mines are shipped when the tonnage of manufacturing grows. The accommodation of animal products, forest and agricultural products to the controllable classifications is one of the curious results of our study. If the lows of the classifications are added, the result is 89 per cent; if the highs of each of the classifications are added, the result is 112 per cent. The variation in percentage of a given class is very small. This is not true of the totals. Agricultural tonnage increased by over 12 million from 1917 to 1918. Products of mines decreased from 801 to 640 million from 1918 to 1919, and many other equally large changes in the total tonnage of a given class might be cited.

We shall now study each of the classifications by itself, taking them in the order of size of the tonnage moved.

Products of Mines

Products from mines constitute from 51 per cent to 58 per cent of the total tonnage moved on the railroads of the country. The average tonnage moved since 1899 is about 520 million and the average annual increase is about 20

million. Table 5 shows the year of highs or lows, tonnage moved, and the relation of each year to normal. The movement may be characterized roughly by saying that it was above normal between 1905 and 1918 and below normal the remaining time.

The greatest movement of products of mines came in the year 1917, with 801 million tons, and in 1918, with 800.7 million tons. The year of smallest movement was 1899 with 258 million tons.

TABLE 5

YEAR	TONNAGE MOVED	RELATION TO NORMAL
1901	302 million	11 per cent below
1904	368 "	8 per cent below
1907	522 "	14 per cent above
1909	490 "	2 per cent below
1913	672 "	16 per cent above
1915	568 "	9 per cent below
1917	801 "	19 per cent above
1919	640 "	10 per cent below
1922	532 "	31 per cent below

Manufactured Products and Miscellaneous

From 16 per cent to 22 per cent of the tonnage moved belongs to the class of manufactured products and miscellaneous. The ratio of tonnage varies little from year to year and averages 18 per cent. The greatest tonnage is 273 million in 1920; the smallest tonnage, 94 million in 1899. The average annual increase is 5.6 million tons.

TABLE 6

YEAR	TONNAGE MOVED	RELATION TO NORMAL
1899	94 million	19 per cent below
1907	200 "	25 per cent above
1909	151 "	12 per cent below
1915	174 "	15 per cent below
1917	263 "	20 per cent above
1919	228 "	1 per cent below
1920	273 "	16 per cent above
1921	186 "	23 per cent below

TABLE 10. INDEX OF TONNAGE MOVED

YEAR	AGRIC.	ANIMALS	MINES	FORESTS	MFG. AND MISCEL.	L. C. L.
1899	82.1	82.5	67.0	65.1	66.2	77.2
1900	88.1	88.3	79.7	80.7	75.4	85.1
1901	91.7	89.6	78.3	81.2	84 5	83.2
1902	88.6	91 6	89.4	91.3	91.7	64.2
1903	99.7	99.1	95 7	99.4	100 3	114 9
1904	100.0	103.2	95 7	106 7	94.5	118.2
1905	103.4	105 1	109 2	105.2	106.8	116.2
1906	112.0	109.6	123 6	120.1	131 1	124.7
1907	123 0	118.0	135.5	132.6	141.0	95.0
1908	110.9	112 8	125 9	117.7	108.7	120.4
1909	114.7	115 7	127.3	123.4	106 6	123.1
1910	121.8	113 7	149 9	142.8	131.8	128.8
1911	129 5	130 1	145 2	134 2	127 1	128.6
1912	136 8	136 0	152 0	123 3	129 5	134.7
1913	160 0	144 1	174 6	138 0	142 2	149.3
1914	144 0	147 8	167 9	136 5	130.4	145.7
1915	158.5	143.6	147 6	114 5	122.9	177.2
1916	164.0	168 1	195 3	136 0	172 6	215 6
1917	157.0	183 7	208 0	131 5	185.4	201 2
1918	174.7	205 5	208 0	126 4	173.8	199.5
1919	172.2	203 3	166 3	121 7	161.1	190.8
1920	165.7	152 4	200.8	130 3	192.9	198.0
1921	170.3	138.5	143 6	99 2	131.5	155.9
1922[a]	153 2	138.4	138.3	106 2	155 5	147 9
1923	159.7	147 4	196 0	143 2	189 0	154.0[b]

[a] Class I roads only Years previous to 1915, fiscal years ending June 30; beginning with 1916, calendar years.
[b] Estimated.

HIGHS FOR THE SEPARATE CLASSES

YEAR		INDEX	TONNAGE ORIGINATING	RELATION TO NORMAL
1918	Agriculture	174 7	126,532,038	6% above
1918	Animals	205 5	38,964,708	24% above
1917–18	Mines	208 0	801,009,852	19% above
1910	Forests	142.8	119,791,591	25% above
1920	Mfg. and Miscel.	192 9	273,417,658	16% above
1916	Less than carload	215 6	63,227,787	3% above

Estimates of Tonnage Originating and Average Haul in 1933

If the growth of traffic continues for the various commodities at the same rate as during the last two decades, the tonnage originating for 1933 as calculated from these trends will be, in million tons, as follows:

Products of agriculture	169.7
Products of animals	43.7
Products of mines	982.6
Products of forests	126.0
Manufacturing and miscellaneous	306.9
Less-than-carload	75.4
Total tons originating	1704.3
Tons originating, 1921	1017.8

If, now, we take the estimated ton-miles for 1933, given as 565,000 million by the Sub-Committee on Statistics of the United States Chamber of Commerce, and divide that estimate by the above estimated tons originating for 1933, we get: 565,000 ÷ 1704.3 = 331.5 + miles, for the average haul in 1933. The record of average haul has been as follows: 1900, 242.73 miles; 1910, 249.68 miles; 1920, 307.51 miles.

The figure arrived at above for the average haul means an annual increase of about two miles per year from 1920 to 1933. The average annual increase from 1910 to 1920 was 5.8 miles; from 1900 to 1910 about 0.7 miles. The large increase of the decade ending in 1920 is partly due to the War. It seems reasonable to assume that the increase experienced in that decade will not be duplicated in the decade from 1923 to 1933. Another factor that would tend to lower the rate of increase is that the longer the haul, the more likely it is that attempts will be made to shorten it by moving factories nearer to the supply of raw material or by increasing the productiveness of farms nearer the markets.

Comparison of Production and Tonnage Originating: Products of Agriculture

Day's index of production for agriculture includes the following products: hay, tobacco, cotton, corn, oats, wheat, barley, rye, rice, white potatoes, sugar, and flaxseed. Day forms his index by getting for each commodity its percentage of the average year 1909–13. He then weights each commodity in accordance with its average value for 1909–13 and combines the commodities by taking the geometric mean of the weighted percentages.

We have constructed an index of tonnage originating, by using the method which Day employed. Three of the commodities, hay, tobacco, and cotton, are in both classifications, and Day's weights for them may be used. We need a weight for grain in the I.C.C. classification. This is obtained by multiplying each of Day's commodities that are not common to the two classifications, by Day's weight; the sum of these products then being divided by the sum of the commodities. The weights for the classifications of tonnage originating are: hay, 757.1; tobacco, 101.9; cotton, 919.9; grain, 6475.8.

We next get for each of the four I.C.C. classifications, its percentage of the average year 1909–13. These percentages are weighted with the weights just obtained, and the geometric mean of the weighted percentages is taken. The result is an index of tonnage originating that is comparable with Day's index of production.

The average annual percentage increase is the slope of the trend line and is the more dependable for comparison of the relative increases in tonnage originating and production. It shows the normal percentage increase in the two items. Both the average annual percentage increase and the per cent of increase in 1914 over 1899

TABLE 11. INDEX OF TONNAGE ORIGINATING

YEAR	INDEX OF TONNAGE ORIGINATING	INDEX OF PRODUCTION
1899	67.1	80.4
1900	69.7	80.9
1901	72.2	71.8
1902	66.7	91.4
1903	75.3	84.4
1904	76.2	93.3
1905	79.4	94.5
1906	88.3	100.5
1907	92.9	90.4
1908	82.7	95.5
1909	86.1	95.0
1910	90.8	99.1
1911	99.7	94.1
1912	101.0	111.0
1913	121.3	98.2
1914	112.8	108.5
Increase 1914 over 1899	68%	35%
Average annual increase 1899–1914...	3.01%	1.54%

show that, during this period, the amount of products of agriculture that were shipped on the railways of the country increased just about twice as fast as did the production of these products.

Comparison Indexes of Each of the Four I.C.C. Classifications

In Table 12 we compare the indexes of tonnage originating and tonnage produced for the four I.C.C. classifications. Taking the arithmetic mean of the percentages of increase of the four classifications gives the following:

TABLE 12. TONNAGE ORIGINATING COMPARED WITH TONNAGE PRODUCED

(Average of the years 1909–13 = 100)

Year	Grain		Hay		Cotton		Tobacco	
	Tons originating	Tons produced	Tons originating	Tons produced	Tons originating	Tons produced	Tons originating	Tons produced
1899	66 7	87 1	55 9	85.6	80.1	71.7	72.8	89.0
1900	71.0	86.6	64.8	79.3	64.1	77.7	78.9	83.5
1901	72 6	70.0	64.4	83.2	76.5	73.0	73.9	84.0
1902	65 0	96.1	73.8	97 3	72 3	81.6	77.0	84.3
1903	74.4	84.8	73 2	101.6	82.0	75.6	90.9	83.7
1904	75 2	90 6	82.4	103.1	77.7	103.1	79.1	67.7
1905	76.2	99 5	81 9	108 7	102 4	81 1	87.9	64.9
1906	88 4	103 1	86 4	98 9	88 6	101 9	93 0	70.0
1907	90 5	87 4	92 2	107 7	111 9	85 2	97.8	71 6
1908	81 5	89 5	85 9	116 9	88.3	101.6	84.6	73.6
1909	84 1	95 9	86 0	110 8	102 0	76 7	83.7	97.4
1910	92 2	103 0	94 2	103 4	78 1	89 1	99.4	113.2
1911	101.2	89 5	99 4	81 8	90 1	120 4	98 4	92.8
1912	96 9	116 1	107 7	108 3	128 0	105.1	103 5	98.8
1913	125.6	95 5	112 6	95 6	101 8	108 6	115.0	97.8
1914	113 4	103 5	115 4	104 4	107.0	123.8	112.9	106.1
Increase 1914 over 1899	70%	19%	106%	22%	34%	73%	55%	19%

Average per cent increase in shipments . . . . . 265 ÷ 4 = 66
Average per cent increase in production . . . . 133 ÷ 4 = 33

The production of all commodities except cotton has increased more slowly than shipments. Raw cotton is usually shipped but once, so that for this commodity production is nearly as large as shipments. The production of hay, which is consumed mainly upon the farms where it is produced, is from fifteen to twenty times its shipments. The amounts of tobacco shipped are nearly double the amounts produced. This is partially accounted for by imports of tobacco, but not entirely, since imports form only about one twentieth of the amounts

produced. The excess of tons originating over tons produced is largely due to reshipment.

Comparison of Production and Tonnage Originating, Tobacco, 1915-22

Day gives the figures for tobacco production for the years 1919–22, inclusive, on page 199, *Review of Economic Statistics*, July, 1923. The figures for the years 1915–18 are taken from the *Statistical Abstract*. For the years in which these sets of figures may be compared, a slight difference is found in the two estimates of production.

TABLE 13

YEAR	TOBACCO PRODUCTION (thousand tons)	TONS ORIGINATING (thousand tons)
1915	531	991[a]
1916	577	1016
1917	625	1029
1918	720	1160
1919	733	1293
1920	791	1083
1921	535	933
1922	663	884

INDEXES
(1919 = 100)

YEAR	PRODUCTION	TONS ORIGINATING
1915	72.4	76.6
1916	78.6	78.6
1917	85.2	79.6
1918	98.2	89.7
1919	100.0	100.0
1920	107.9	83.8
1921	73 0	72.2
1922	90.4	68.4
Average annual increase 1915–22	2.31%	0.01% (decrease)

[a] Obtained by combining fiscal years 1915 and 1916 to get the calendar year. The average seasonal movement for tobacco for the years 1920, 1921, 1922, showed that 53.1 per cent of the total tonnage was moved during the first six months, and 46.9 per cent during the last six months of the year.

The increase in production of tobacco is now greater than the increase in tons originating (which over the whole period 1915–22 actually shows a very slight decrease). This is in sharp contrast with the results obtained from the study of the period 1899–1914. The higher freight rates during the later period have probably caused those handling tobacco to reduce reshipments to a minimum. It would be interesting if the average haul for tobacco were available for comparison for the two periods. For 1922, the tons originating were 133.3 per cent of the tons produced as compared with 200 per cent or more in most of the years from 1899 to 1914.

Comparison of Production and Tonnage Originating, of Products of Animals, 1909-22

Day includes under the title, "Animal Husbandry," series for the following items: cattle, calves, whole milk, hogs, sheep, wool, poultry, and eggs. These series were obtained from 1899 to 1921 with the exception of milk, poultry, and eggs which were not available before 1914. This index is made up by the same method as his old index, namely, by taking the geometric mean of the items of the separate series. The inclusion of milk, poultry, and eggs after 1913 would not disturb the continuity of the index.

The index for tonnage originating is simply the total tonnage with no attempt at weighting the separate items. It is believed that the two indexes will be comparable.

The decrease in tonnage originating after 1919 tends to equalize the rates of increase in the two series given above; but the rates of increase before 1914 show that tons originating were increasing much faster than tons produced. Since 1918, tonnage originating has shown a great decline; while production, according to the Day

TABLE 14. PRODUCTS OF ANIMALS

(1919 = 100%)

	Index of Tonnage Originating	Index of Production
1909	56.4	82.8
1910	60.1	75.0
1911	65.5	87.0
1912	69.0	84.3
1913	71.8	83.9
1914	71.6	80.3
1915	75 1	86.1
1916	82.7	93.6
1917	90.3	93.2
1918	101.1	103.2
1919	100 0	100.0
1920	75 0	92.5
1921	68.1	92.9
1922	68.1	102.1
Average annual increase, 1909–14	3 38%	0.41%
Average annual increase, 1909–22	2.36%	2.04%

index, has remained nearly at the 1918 level. Reshipments of animal products have been cut down and there have been smaller shipments in all products of animals since 1918.

Production and Tonnage Originating in Products of Mines

It might be assumed that the reduction in the rate of increase of tonnage originating, relative to the rate of increase of tons produced, between the two periods, was due to the increasing use of the motor truck. Many of the tons that might have "originated" on the railroads were carried to their destination by truck. To test such an

assumption, we shall examine the products of mines. No important amount of this classification is moved by motor truck, as these bulky products, with a low value per unit of volume, cannot be economically transported by truck.

Using Day's index of production for products of mines and constructing an index of tons originating with the same base, we can compare production and shipments. Owing to changes in the classifications of the Interstate Commerce Commission in the later years, the index for tonnage originating is obtained from the tonnage for each year, with no attempt at weighting the various commodities. These indexes are compared in the following table, first, for the period 1899–1914, inclusive; then for the period 1915–22. They show a close agreement, especially during the first period.

Products of mines, tons originating, and tons produced have both decreased since 1914. But tons originating have decreased at a much faster rate. This is in agreement with the findings in the case of products of agriculture and products of animals. Products of mines show a tendency to decrease reshipments.

It may well be true that the motor truck, instead of absorbing some of the tons originating, has actually tended to help keep the tons originating for products of agriculture and products of animals on an upward trend since 1914, instead of decreasing as in the products of mines. It is not safe to draw this conclusion upon the basis of the fact that tons originating in products of mines have shown a decrease, since the fluctuations, both in production and in shipment, of products of mines are sharper and of greater amplitude than the fluctuations in products of agriculture and products of animals.

TABLE 15. PRODUCTS OF MINES

(average 1909–13 = 100)

YEAR	INDEX OF TONNAGE ORIGINATING	INDEX OF TONS PRODUCED
1899	44.7	48.5
1900	53 2	51.3
1901	52.3	55.6
1902	59.6	59.5
1903	64.0	65.5
1904	63.4	66.1
1905	73.0	78.4
1906	82.5	82.4
1907	90.5	90.2
1908	84.1	74.8
1909	84 9	91.9
1910	100.0	97.8
1911	96.9	94 3
1912	101 4	105.1
1913	116 5	110 2
1914	112.1	98.3
Average annual increase	4.58%	3.99%

(1919 = 100)

YEAR	INDEX OF TONNAGE ORIGINATING	INDEX OF TONS PRODUCED
1915	100.0[a]	93.3
1916	117.3	104.8
1917	125.2	112.2
1918	125.2	112.7
1919	100.0	100.0
1920	120.8	114.2
1921	86 4	91.6
1922	83.1	97.5
Average annual decrease	4 84%	1 23%

[a] Fiscal years 1915 and 1916 combined to produce calendar year 1915.

Traffic Increases by Districts, 1899-1922

It remains to compare the growth of traffic in various geographical sections of the country.[1] The earlier reports of the Interstate Commerce Commission divided the country geographically into ten groups. Groups I, II, and III correspond closely to the present Eastern District, except that the Eastern District includes about half the State of Illinois. Groups IV and V of the earlier divisions are precisely the same as the present Southern District. Groups VI–X correspond to the present Western District, except that the eastern half of Illinois is now included with the Eastern District. The detailed table below shows the revenue passenger-miles and revenue ton-miles for these districts by years from 1899 to 1922. These figures show that the Southern District had the greatest relative growth both in passenger-miles and in ton-miles. The Eastern District had the greatest absolute growth in both freight and passenger traffic and the smallest relative growth.

TABLE 16. TRAFFIC BY DISTRICTS

(Per cent that 1922 is of 1899)

DISTRICT	PASSENGER-MILES	TON-MILES
Eastern	228	227
Southern	324	477
Western	243	279

AVERAGE ANNUAL INCREASE

(Million)

DISTRICT	PASSENGER-MILES	TON-MILES
Eastern	545	5404
Southern	249	2950
Western	415	3606

[1] Table 17 shows the growth of railway traffic in various geographical districts from 1899 to 1922.

TABLE 17. GROWTH OF RAILROAD TRAFFIC IN THE UNITED STATES BY GEOGRAPHICAL DISTRICTS

(Unit: one million miles)

Year	Eastern District		Southern District		Western District	
	Rev. passenger-miles	Rev. ton-miles	Rev. passenger miles	Rev. ton-miles	Rev. passenger-miles	Rev. ton-miles
1899	7,933	66,649	1,501	14,578	5,157	42,440
1900	8,692	75,044	1,502	17,097	5,845	49,458
1901	9,150	75,562	1,682	17,937	6,522	53,578
1902	10,241	78,727	1,854	19,397	7,596	59,155
1903	10,681	87,046	1,983	20,935	8,252	65,240
1904	11,026	87,010	2,116	21,738	8,781	65,774
1905	11,532	93,949	2,376	23,578	9,893	68,937
1906	12,291	107,489	2,434	27,253	10,443	81,136
1907	13,355	117,961	2,799	28,816	11,564	89,825
1908	13,544	108,302	3,005	26,979	12,534	83,101
1909	13,249	106,376	2,907	28,574	12,953	83,852
1910	14,400	125,025	3,223	33,840	14,716	96,152
1911	15,512	130,834	4,175	41,712	13,515	81,237
1912	15,745	134,947	4,335	44,250	13,052	84,884
1913	16,397	154,173	4,490	48,543	13,689	98,683 Class I
1914	16,649	144,428	4,698	50,132	13,911	93,760 Class I
1915	15,228	136,796	4,076	47,894	13,080	92,139 Class I
1916	16,862	178,898	4,669	62,298	13,591	124,576 Class I and II
1917	18,408	187,966	5,777	68,371	15,292	138,128 Class I
1918	19,517	190,943	7,405	72,101	15,755	142,335
1919	21,471	170,118	7,099	64,000	17,788	130,176
1920	21,927	188,518	6,618	76,925	18,304	144,863
1921	18,723	138,503	5,085	59,679	13,504	108,658
1922	18,083	151,210	4,856	69,565	12,531	118,511

PER CENT THAT 1922 IS OF 1899

	Passenger-Miles	Ton-Miles
Eastern District	228	227
Southern District	324	477
Western District	243	279

The most surprising fact that is brought out by this study of traffic increases in the various sections of the country is the more rapid increase of ton-miles in that portion of the United States where the ratio of rural population is the highest. The Southern District has increased far more rapidly than either of the other two.

Since the growth of manufacturing activity and of mining output has outrun the increase in agricultural output by more than fifty per cent during the last twenty years, this seems illogical. On second thought, however, it is clear that manufacturing output is sold in these very rural districts remote from the centers of manufacture. The volume of traffic relative to that of twenty years ago will depend upon the relative purchases of factory products by the farming community. This in turn will be determined by the economic surplus of these districts. Every one who has studied the increase in production and prices for American agriculture knows that this surplus has increased greatly during the last twenty years. The habit of production for home consumption has declined also. The farmer buys a much larger number of things than he used to, and sends his products to market in their raw state. Whatever the reason may be, the fact is clear that the southern portion of the United States is the section where transportation is increasing most rapidly.

For the future, the volume of transportation must be determined primarily by the growth of production. That growth has been remarkably even over almost half a century, and will probably continue so. The interesting possibilities are the relocation of industry, especially of agriculture, much nearer the center of consumption; the development of water transportation via the Panama Canal; and the shift of high-grade commodities and less-than-carload-lot freight to the motor truck. Any one of these factors would make an appreciable change in the growth of revenue ton-miles of freight carried. If all were operating in the same direction, they might well bring about an important check in the rate of growth for railway traffic. Thus far, there is not sufficient evidence upon the probable development of any one of these factors to warrant a prophecy.

CHAPTER VII

NEW DATA NEEDED FOR FORECASTING

By FRANCIS WALKER

IN the scientific study of the business cycle, there are three chief aims: (1) to determine fully the causes of business cycles and the processes of their development; (2) to discover, from the usual sequence of events, what facts reveal an approaching crisis and the inevitable depression which results therefrom; (3) to consider what corrective measures may be taken to mitigate the extent of the oscillations of the business cycle, and the bad effects resulting from such crises and depressions as cannot be wholly prevented. Concisely stated, the problem is to understand, to forecast, and to stabilize industry.

If some of the suggestions made here seem to involve a good deal of labor and expense, it should be remembered that the evils to be prevented are enormous, both from the point of view of material wealth and from that of human misery. Viewed from the former and perhaps less important standpoint, it has been estimated by eminent statisticians that the fluctuations of the business cycle for the ten years 1909–18, inclusive, cost the people of the United States no less than $8,865,000,000 in loss of national income, or nearly a billion dollars per annum.[1]

It is important to note that the prevailing trend of thought attaches great significance to the fluctuation of profits as a powerful and pervasive factor in the development of the business cycle. Especially the costs of production in relation to the prices of commodities are

[1] *Business Cycles and Unemployment*, New York, 1923, p. 39.

asserted to exert a major influence. Professor Wesley C. Mitchell, in his comprehensive treatise on this subject, lays special emphasis on these factors, and various other authorities base their theories of crises largely upon the changes in profit.

It is obvious, also, even apart from the consideration of the particular problem of the business cycle, that our system of private industry for its efficient working presupposes that there will be a gradual flow of capital into the industries that are undeveloped and earning relatively high rates of profit, and a flow out of industries in which there is an overdevelopment, and where there are losses, or relatively low rates of profit. Such a flow occurs at the present time, but it is not always in the right direction, because some men do not know the true general conditions. For this reason, maladjustments in investment take place. These are vastly more serious than subsequent maladjustments of prices, which are much more capable of timely rectification, without individual loss and social waste. In other words, one of the best ways to minimize the extremes of the business cycle is to make public the average rates of profit in the various branches of industry.

Little use has been made of these significant items of information, profits and costs, by most of those who have worked in the field of business cycles. One obvious reason is the fact that such data are not generally available, or else not available in a satisfactory form. As to costs of production of staple commodities and the margins of profit between such unit costs and unit prices, there is very little current information at hand, except sometimes to members of trade associations in particular branches of industry, and, sporadically, in reports of government investigations. The latter, while containing much valuable information, have not been sufficiently

comprehensive or continuous to afford adequate information regarding business cycles.

As to profits of business, certainly more comprehensive information is available in the industrial handbooks; but the data have not been suitably compiled, and the profits are often reported in a very inadequate and unsatisfactory form, as, for example, after payment of Federal taxes. As a consequence, for the purposes of actual study of this factor, chief reliance seems to have been placed hitherto on the earnings of railroad companies, as compiled and published by the Interstate Commerce Commission, with occasional reference to other and sporadic data, such as the earnings of banks, or of the United States Steel Corporation. It does not need any argument to show that the earnings of the railroads, with more or less fixed rates as the basis of earnings, furnish no reliable indication of the course of business profits generally. The reports of the Steel Corporation furnish valuable data for a large portion of the steel industry, but there is not sufficient reason to assume that the trend of its profits represents very accurately the movement of profits in manufacturing business generally, to say nothing of trade and finance.

There is being gradually developed, however, through the Income and Corporation Tax Statistics of the Treasury Department, a valuable summary of the annual profits of incorporated companies engaged in industry and trade. These figures are very useful; but they have the great drawback, from the point of view of the study of the nature of the business cycle, that they are for a few annual periods only, while from the point of view of prognostication of the future trend of business, the long delay in their publication makes them entirely unserviceable. In spite of these drawbacks, they deserve careful

study. For example, the differences shown in the trend of the average rates of return for the various groups of corporations are very marked. The reported rates of net income to invested capital for 1919, 1920, and 1921 are shown in the following tabulation: first, for the principal groups of corporations; and, second, for particular branches of manufacturing industry.

TABLE 18. PROFITS OF CORPORATIONS

RATE OF NET INCOME TO INVESTED CAPITAL

	1919	1920	1921
Agriculture	12.2	11.7	12.6
Mining and quarrying	10.2	14.4	6.2
Manufacturing	19 9	14.6	13.0
Construction	25.6	17.9	16.1
Transportation	6.4	6.3	7.8
Trade	19.9	15 7	15.8
Public service, hotels, etc.	13.6	16.7	18.2
Finance, insurance, etc.	7 9	6.3	9.0
Mixed	10 6	9.0	11.4
In liquidation	5.9	5 8	..
Inactive	7.4	4.5	..
Total	14.1	11.3	11.1

MANUFACTURING GROUPS

RATE OF NET INCOME TO INVESTED CAPITAL

	1919	1920	1921
Food, liquor, tobacco	24.2	12.9	16.3
Textiles and textile products	27.9	17.8	17.5
Leather and leather products	30.3	14.7	16.8
Rubber and rubber products	18 8	6.6	15.6
Lumber and lumber products	17.0	17.9	13.5
Paper and pulp and products	17.4	28.7	13.5
Printing and publishing	19 8	22.1	20.8
Chemical and allied lines	16 0	16.0	17.5
Stone, clay, and glass products	14.3	17.0	14.5
Metals and metal products	17.7	11.9	8.2
All other	19.8	14 4	12.5
Total	19.9	14.6	13.0

Taking all the corporations combined, the trend was downward for the three years 1919, 1920, and 1921; but, considering the several classes, in four instances out of eight, the highest rate was in 1921, and in one case, in 1920. Taking the manufacturing corporations only, the average trend was downward also; but, considering the several industries in this class, in four cases out of eleven the highest rate was in 1920, and in one case, in 1921.

The metal industry shows a downward trend considerably more pronounced than that of any other industry. This would suggest that it does not form a very accurate measure of the extent of the fluctuations in business profit. It may also be noted that the transportation class does not show a trend of profits like that of the average of all corporations. This is true, not only for the transportation group as a whole, but also for the steam railroad group. The same variations in trend of profit are found for the mining industries, the fluctuations for coal, metals, and petroleum being entirely dissimilar. In so far as manufacturing and mining profits are significant for the business cycle, therefore, it is evident that data should be secured for at least several major divisions of such industries.

If recourse is had to the statistical data of the States, the available information is much less satisfactory. Excellent data on corporation profits are apparently obtained by Massachusetts in its Business Corporation Excise Tax Returns, which include quite elaborate balance-sheet and income statements; but the figures, unfortunately, are no longer published and have never been compiled in a convenient form for this purpose. Pennsylvania also obtains elaborate corporation reports relating to both investment and earnings; but the data, unfortunately, are not published. The taxation returns of Connecticut include detailed income statements, but

inadequate data on investment. It is understood that the data reported by corporations in Wisconsin are fairly complete for the purpose of determining the rate of profit on investment, but apparently they are not compiled for publication. The State tax data, like those of the Federal Government, are limited to yearly returns, which are hardly frequent enough for some of the most important purposes of analysis of the business cycle.

The second subject on which information is suggested above, as necessary for a better understanding of the business cycle, is with respect to unit costs, prices, and margins of profit of staple commodities. Where staples are produced in large quantities, whether in production to stock, or upon the basis of orders received in advance of production, it is convenient and customary among most well-operated companies to determine the monthly production costs for comparison with the current realizations from sales; that is, the average selling prices. Such data reflect in a very accurate manner the trend of business prosperity. The cost sheets show, not only fluctuations in raw material costs (except where large stocks are carried), but also the real changes in labor expense for which data on changes in wages are often a very deceptive guide. The realizations from sales, also, reflect more exactly the real conditions of business operation than current price quotations, which often do not apply because of long-term sale contracts and other reasons.

Information on cost of production has varying degrees of utility in preventing extremes in the business cycle, depending on the recency of the data. Sometimes, cost figures a year or more old may be of some value, if the industry is a stable one; but fresh data are being constantly produced, which have a vastly greater utility in preventing improvident business action.

While in various government publications and in engineering literature considerable information may be found regarding past costs of production and the margins of profit per unit, there is little current information now available, apparently, except in the compilations of certain trade associations. The Federal Trade Commission in 1920 inaugurated a regular monthly service of this character for certain basic industries, but was prevented from carrying out the plan by judicial injunctions. On the other hand, certain recent judicial decisions have made many trade associations hesitate to engage in the practice of compiling and circulating such data among their members. Provided the legal questions are favorably determined, it would seem most feasible that such work should be undertaken by governmental authority in order to afford the best possible guaranty of accuracy and completeness.

The principal suggestion is that for a number of the most important basic industries, particularly those producing staple goods which can be measured in quantity as well as value, there should be established a system of reporting monthly the desired facts to a central agency which would combine the data and publish them immediately. The facts to be reported should include, for specified products in each industry: (1) the quantities sold and the average selling prices; (2) the quantities produced and the average costs of production, including items for raw materials and labor; (3) the orders received during the month in quantities of the specified goods, and the total of unfilled orders outstanding; (4) the capacity of the plant for the production of each commodity; (5) the stocks of specified raw materials and finished products. Where there is practically only one product, or one important product, the monthly cost statement could be

combined with the data on sales in a way to give the operating profits per unit for each month.

For some industries certain of these items might be left out. Doubtless in others new items might be called for to great advantage. Thus stocks of raw materials are important in the lumber industry or the tobacco manufacturing industry where they are held for the purpose of maturing them, but relatively unimportant in the steel industry or the coke industry. So, also, in finished products, stocks are important in the implement industry or the furniture industry, where the production programme is figured out long in advance, but less important in the newsprint paper industry, where shipments are largely made on long-term contracts. In addition to these monthly reports on the above-mentioned items, the companies engaged in these basic industries should furnish reports each quarter regarding their net earnings, and each year they should furnish a balance sheet. Thus, the current rate of profit in the industry as a whole could be determined quarterly. Incidentally, certain other items of considerable interest, but of less critical importance, would be made available for, the more particular analysis of conditions.

The foregoing items of information would throw a valuable light on the real course of the business cycle not made clear by data now available and would furnish useful indexes for forecasting developments. Such data, taken, of course, in connection with data on credit, general prices, and international trade, would give a more exact basis for understanding industrial conditions and forestalling disastrous depressions in business, such as those from which this country has so severely suffered during the last three years.

CHAPTER VIII

RELATING MANUFACTURING POLICY TO THE BUSINESS CYCLE

By L. D. H. WELD

IN relating manufacturing policy to the business cycle, the first problem is to decide how far we can rely on forecasts of general business conditions, and what forecasts are to be used. This subject does not require consideration here, except to point out that there is often a radical difference of opinion among some of our leading forecasters, and that often one cannot be sure at any particular time (when he needs to determine a manufacturing policy for some months in advance) what business conditions are going to be. For example, to begin drawing on the packing industry for illustrations, there is always a large supply of hogs during the winter months. A large quantity of pork must be put into storage for use during the summer and early fall when the hog supply is light. When we are having unprecedented receipts of hogs, we want to know how much pork we should put away, and how much we should force on the market this winter. It is a problem in the relationship of present prices to next summer's prices.

The uncertainties of business forecasting were well illustrated in the fall of 1923. We had a much greater recession in business activity than some of our best services predicted. Some of the organizations that statisticians think are using questionable methods were nearer right, than other organizations that are supposed to be using the most scientific methods. The point is, of course, that

there is still a lot of work to be done before we, who are facing real business problems, can be sure that we have something on which we can rely. Not that we need or expect infallible prediction. There are too many factors which are either fortuitous, or on which it is impossible to get data. Among the fortuitous factors may be mentioned wars, political changes at home and abroad, strikes, and crop failures. Among factors on which there is not enough knowledge are the following: costs and profits of industry; invisible stocks of goods on hand; effect of the Federal Reserve System on industrial conditions; and the workings of mass psychology. But substantial progress has been made, and we may expect further progress.

The question is, how can an individual manufacturing concern relate its policies to the business cycle? Before enumerating some of the difficulties encountered by an individual company, let me point out that oftentimes one industry, so-called, may really be a combination of industries, and that each branch presents special problems and requires separate treatment. For example, in the packing industry, cattle, hogs, and sheep each have to be studied separately. What we develop on pork operations is of little value in determining policy in the manufacture and sale of glue, or of fertilizer, or of soap. Hides and wool have different relations to the business cycle. Cold-storage operations in butter and eggs present their own problems.

Now, let us enumerate some of the difficulties that an industry is likely to encounter, in relating its policy to the business cycle:

(1) In some industries, production and price policies have to be governed by supply of raw materials, which varies with little or no relation to business conditions.

The iron and steel industry can largely control its raw-material supply, and can therefore relate its manufacturing policy, to a certain extent at least, to business conditions. Not so with many industries that are dependent on raw materials, the supply of which cannot be controlled. This is true of the leather industry, for example, where the supply of hides is a by-product of the packing industry, and cannot be shut off when business conditions are bad. The same is true, to some extent at least, of the oil refiners, because of the difficulty of controlling the output of crude oil. This situation obtains particularly in industries which rely on agricultural raw materials. Flour mills, for example, have to be governed largely by the available supply of wheat. Fruit canners are at the mercy of natural conditions, which may cause a bounteous harvest or a crop failure on the acreage for which they have contracted. The beet-sugar industry is in a similar situation.

Perhaps no industry better illustrates this difficulty than the packing industry. The supply of live stock at any one time has practically no relation to business conditions at the time of marketing. The hogs that are coming to market this winter were born last spring, as a result of breeding during the winter a year ago. The attitude of farmers toward breeding a year ago was largely determined by the supply of corn and the relation between the price of corn and the price of hogs at that time. This takes us back to the corn crop of summer before last as one of the principal determinants of hog supply and hog prices to-day, and for several months to come.

(2) Style changes affect many industries. The leather industry furnishes good examples. This industry was hit harder than most industries during the slump of 1920. But when it was losing millions of dollars on sole leather

and calf skins, it was making good profits on patent leather. This was due simply to the fact that women were demanding patent leather. Bright red and green leathers were moving well last spring and summer. Nobody could have foreseen this absurd whim. The demand finally ceased more abruptly than it began.

(3) Some concerns lack reliable data covering a long enough period. They are too young to have data running back over a series of pre-War years. Others have inadequate records, especially of monthly data. Others have sufficient data, but the task of collecting it may be very wearisome.

(4) New inventions and changes in industrial processes are another factor that makes it difficult to plan ahead. The automobile industry has had its effect on the carriage industry and on street-railway companies. It has recently been claimed that young men are spending so much in buying and maintaining automobiles that they are spending less money on clothing. Many other examples could be recalled.

(5) Introduction of substitutes. The use of rubber heels, of composition soles, and of wooden heels on women's shoes has played its part in putting the sole-leather industry into a long period of distress.

(6) The need of making plans far in advance. I have already referred to the problem now facing the packing industry, as to what policy it should follow in storing pork products for consumption next summer and fall. The canning industry has to make contracts during the winter for fruit and vegetables that are not yet planted, and that will be sold the next winter. The farmer's problem is difficult; he has to plan his planting or his live-stock raising several months, or even a year or more, before his product will be offered for sale.

(7) Changes in government policy with regard to tariff, regulation of industry, immigration, etc.

(8) Changes in foreign conditions affecting those industries that rely largely on export markets.

(9) Some industries are too new to make it possible to figure out their relationship with the business cycle. The radio industry is a good example.

Many other difficulties might be mentioned. At present we are still worried about the maladjustments between industries and prices caused by the War. In our statistical computations, we find it difficult to determine what the new normal levels of production and prices are, or what their secular trends will be.

There are other things that are not only difficult to foresee, but hard to explain after they have happened. The Harvard Committee made an interesting and helpful study of the relation between hide and leather prices and the business cycle. This relationship was very marked from 1903 to 1912, but, when the depression of 1913–14 came, leather prices kept right on going up during the decline in general prices that lasted until the outbreak of the European War. Again, since 1921, heavy leather has failed to respond to the upward tendency of the general price-level, and consequently, even during 1923, severe losses were suffered by tanners. In other words, the relationship established by the Harvard Committee between leather prices and the business cycles has fallen down twice in the past ten years, exclusive of the War years themselves. Recently, in my own office, we worked out two curves depicting a relationship between hog receipts and corn supply. This worked well for twenty years, including even the War years; but fell down badly for the first time in 1923. This illustrates the need of constant study of all possible factors bearing on any particular problem.

The enumeration of these difficulties suggests the reasons why some industries conform to the business cycle more closely than others. There are some whose ups and downs correspond very closely with the ups and downs of business, such as the railroads, and other public utilities, including the American Telephone and Telegraph Company, the iron and steel industry, and building construction. There are other industries, such as the leather industry, and the textiles, that conform to business conditions fairly well, but in which exceptional years frequently happen. There is a third class of industries, such as sugar refining and agricultural production, in which departure from the business cycle is more frequent than conformity.

The principal factors that determine how closely an individual business conforms to general business conditions appear to be as follows:

(1) Universality of use of product manufactured, or service rendered.
(2) Whether an industry is new or established.
(3) Whether it can control the raw-material supply and output of product.
(4) The extent to which it depends on foreign markets.
(5) The extent to which it is affected by style changes.
(6) The extent to which it has to plan far in advance.
(7) The extent to which substitute articles can be used.

In conclusion, it should be said that, although the difficulties enumerated herein are formidable, at least in some industries, they are not necessarily insurmountable. But they can be overcome only through painstaking work, and by giving particular attention to the special factors in each individual industry. The principal value of accurate forecasting to any particular business is as a measure of

probable demand. If the supply cannot be controlled and cannot be foreseen, as in the case of agricultural products, complications begin. But even in the most erratic industries, business conditions are an exceedingly important factor, and attempts to relate an individual business to the business cycle are worth while.

CHAPTER IX

FORECASTING AUTOMOBILE PRODUCTION

BY RAY B. PRESCOTT

EIGHTEEN years ago the automobile business was an infant industry. Production of cars in the year of 1905 totaled 25,000; but by leaps and bounds the output increased until, in 1923, all records were broken by a total production of 3,900,000 cars and trucks. With this increase in production there was an accompanying expansion of plant facilities, a gain in the number of employees and the amount of invested capital, and an enormous increase in the consumption of raw materials. This growth has taken place so rapidly that even the men most closely connected with the industry have scarcely realized its magnitude. Automobile production has increased much more rapidly than crude rubber, oil, pig-iron, copper, or cement production and somewhat more rapidly than steel production.

The desire for individual transportation has smoothed the path of progress of the industry and has eliminated or hidden, for the time being, problems which, in the last five years, have assumed major importance. Early problems of the industry were concerned mainly with production. The market was there: it remained only to fill the demand. The situation to-day is radically different. Production problems are a minor factor: they have given way to the one big problem of marketing and sales analysis.

In natural sciences, a law of growth has long been recognized. The growth of population seems to follow it, and it

seems also to prevail in the industries, especially in those that are a direct function of population. There are variations and exceptions. For example, all extractive industries are an exception because, sooner or later, they reach a maximum production and then decrease.

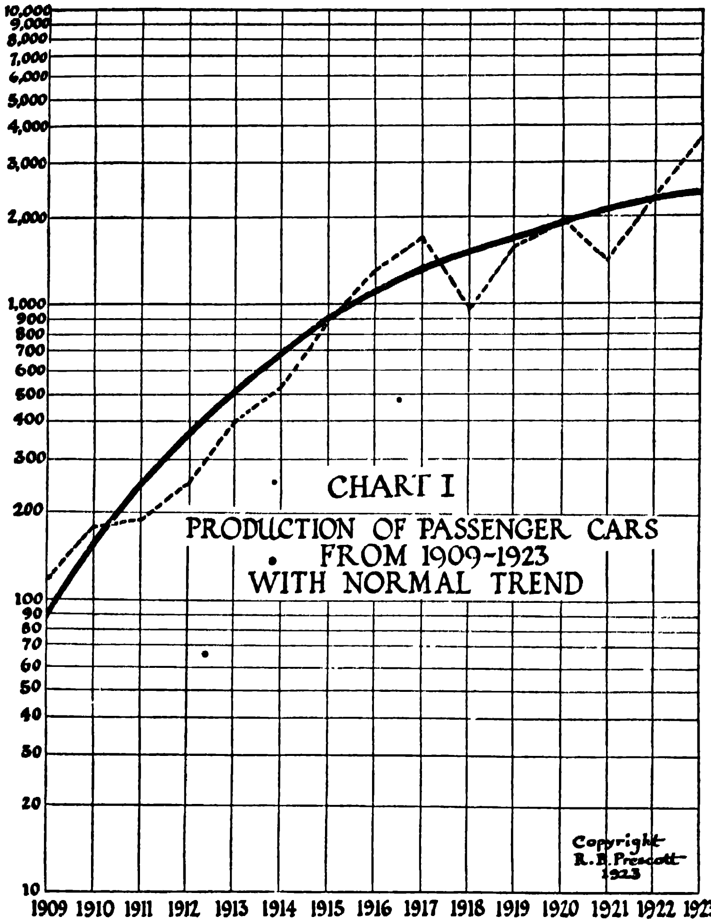


FIGURE 14. PRODUCTION OF PASSENGER CARS IN THOUSANDS WITH NORMAL TREND, 1909–23

The law of growth[1] traces a very definite type of curve. It seems to be best represented by the Gompertz Curve. It passes through three periods: first, experimentation; then, exploitation; and finally, a period of stability. It is possible to conceive of an industry that, having reached the period of stability, receives an impetus which causes it to enter a new period of exploitation and a new period of stability. For instance, the development of the automobile has caused such an enormous increase in the use of rubber that the curve representing the growth of rubber production has repeated itself in the manner described. An improvement in manufacture that caused a marked reduction in the price, or an improvement in an article itself, might have the same effect.

The "Gompertz Curve" ($y = ab^{c^x}$) was fitted to the yearly automobile production data from 1905 to 1923. When plotted, it gave the smooth curve, or normal, shown in Figure 14. The dotted curve shows the actual yearly data. The normal growth on a yearly basis was adjusted and fitted to the monthly data by a method commonly used; that is, by dividing each yearly normal by twelve and placing the adjusted or monthly normal on July of the same year.

Figure 15 shows the normal adjusted to the monthly production data. The fit appears reasonable, because, except for 1915, when the War started, and 1918, when the Government ordered a cut in production of about fifty per cent, the areas above and below the normal line are about equal. The wide deviations from normal in part of 1921 and early 1922 were due to business depression. It will also be observed that production was constantly above normal through the War years of 1916 and 1917,

[1] "The Law of Growth in Forecasting Demand," *American Statistical Journal*, December, 1922.

and has been since May of 1922. The secular trend of normal growth was removed by dividing the actual for each month by its corresponding normal. The ratios thus obtained express each month as a percentage of the normal.

The elimination of seasonal influence from the data offers greater difficulty. It was found, after much experimenting, that none of the means in common practice, such as averaging, taking the medians, averaging of several middle points, or even

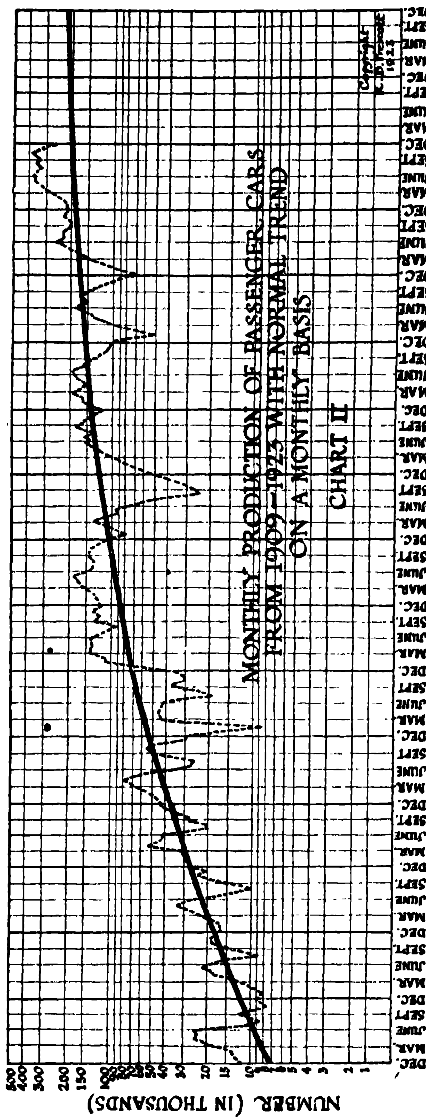


FIGURE 15. MONTHLY PRODUCTION OF PASSENGER CARS WITH NORMAL TREND ON A MONTHLY BASIS, 1909–23

the grouping of several years together, was satisfactory. The seasonal variation seemed to have a yearly change. Through the courtesy of Mr. Harold Flynn, of the American Telephone and Telegraph Company, a method was found for measuring these changes; that is, the method of link-relatives to express each month as a per cent of the preceding month. Then link-relatives of all the Januarys were taken, expressed as a per cent of December, and a curve was fitted to them. The general trend of the link-relatives suggests the type of curve that should be used. The same process is repeated for each month. The points on the curves fitted to the link-relatives of each month are treated as medians and adjusted with January as a basis of one hundred per cent.

Figure 16 shows that the monthly variation in 1910 between the high in April and the low in August was great, having a spread of over two hundred and ten per cent; while in 1918 the spread, between the high months of April and May and low of December, is only forty-five per cent. It will also be observed that there was a more or less gradual change each year, both in spread of high and low and in the general shape. The spread decreased until 1918 and increased thereafter. In 1910, April was the high month. This continued until 1919, when May became a high month. In 1923, June took its place. In 1910, August was the low month and continued so until 1917, when December took its place which place it has since held.

To explain all the changes that have occurred is difficult, but the change in spread is probably due to the new method of financing dealers through the winter months, which enables them to store cars on warehouse receipts held by the banks. Previously, the car manufacturer had to store his own cars to the best of his ability or curtail

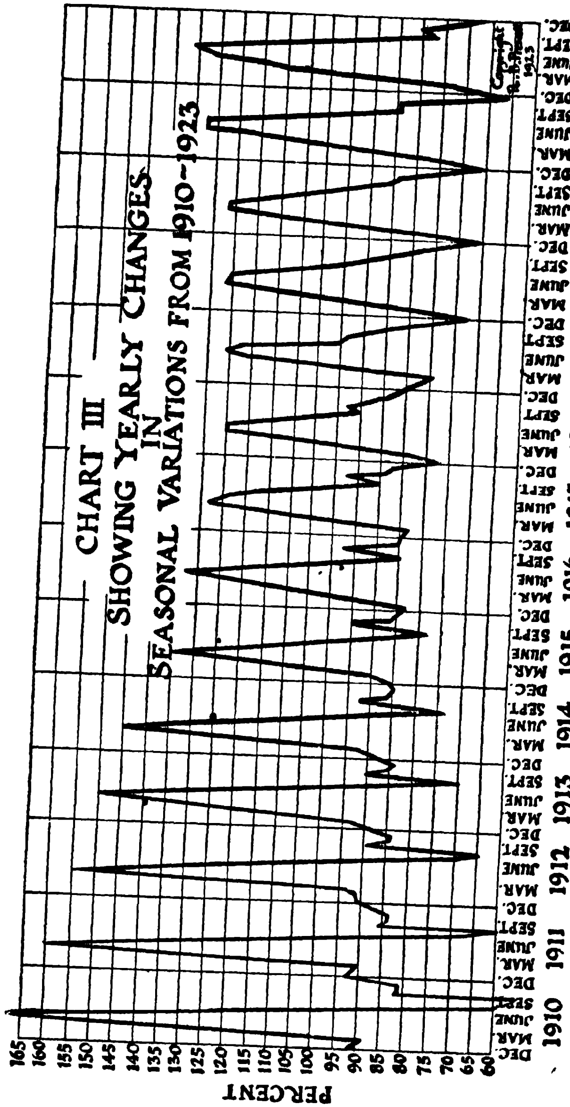


FIGURE 16. CHANGES IN SEASONAL VARIATIONS IN PRODUCTION OF PASSENGER CARS, 1910–23

his production. Most manufacturers did both. Two more factors that probably have had a great deal to do with the changes in the seasonals are the time sales and the increased sale of closed cars, caused by the reduction of the spread in price between the open and closed models.

With monthly data expressed as a per cent of normal, these seasonal variations were subtracted from each corresponding per cent of normal. These differences give a series of points expressed as a per cent above and below normal and reflect only the cyclical fluctuations due to general economic conditions.

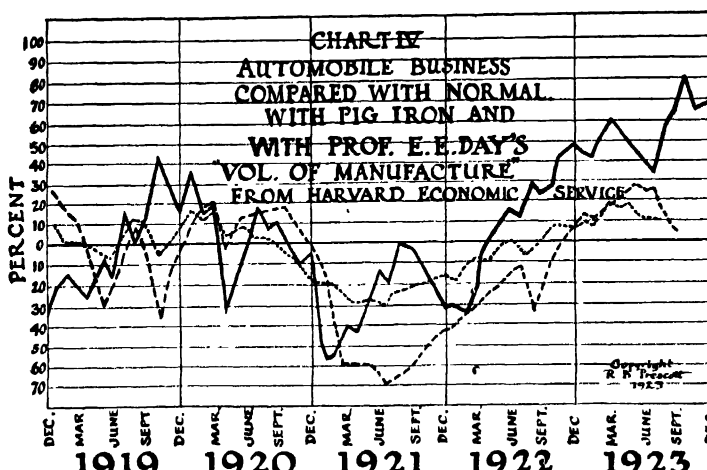


FIGURE 17. ADJUSTED INDEXES OF AUTOMOBILE PRODUCTION, PIG-IRON PRODUCTION, AND THE VOLUME OF MANUFACTURES, 1919–23.

Automobile Business ——, Pig-Iron Production - - - - -, Volume of Manufactures......

Figure 17, which is made from these figures, seems to give a fair index of the automobile industry. On the same chart is plotted Professor Day's "Volume of Manufacture" and pig-iron production, taken from the Harvard Economic Service. It will be observed that automobile

fluctuations precede fluctuations of the "Volume of Manufacture" from three to six months, and that cyclical fluctuations of the automobile industry are much more violent. The movement of automobile fluctuations also anticipates the movement of pig-iron fluctuations. The motor index shows a sharp reaction in 1921, whereas "Volume of Manufacture" and pig-iron do not. This reaction was not a normal recovery of sales, but was due exclusively to sales of Fords to dealers to care for financing purposes. The fluctuations of "Volume of Manufacture" then went twenty-eight per cent below, whereas motors went to fifty-five per cent and pig-iron to sixty-seven per cent below normal.

The problem of forecasting automobile production may be illustrated by the attempt to make a prediction for 1924. The following forecast was made in December, 1923. Figure 17 shows that the automobile production crossed normal in May, 1922, and mounted rapidly until in April, 1923, it reached sixty per cent above normal. This is over forty per cent above the "Volume of Manufacture." In July, there was a reaction from this high point to thirty-six per cent above normal. In October, it bounded up to eighty-two per cent above normal. In March, there was a slight reaction. So, for twenty months, the automobile business averaged about forty per cent above normal. Whether this can continue seems very doubtful.

A review of some of the facts underlying this enormous volume of business will help in shaping our final conclusions. In the first place, the installment-plan method of selling is one reason why so many people are able to buy cars. It is true that automobiles have been sold on time before, but never to the extent reached in the past two years. Prior to the War it was possible to purchase a car

on time, but the arrangements were not always pleasant or easy, while now they are made on what seems to be very weak credit. The period over which these time payments can be made has been increased from four or six to twelve or eighteen months, while some manufacturers are advocating two years. To sell, on such a long-time basis, a product that depreciates from twenty-five to fifty per cent the first year seems rather dangerous. Such sales cannot be compared with furniture and phonographs because such articles do not depreciate as rapidly and can be taken back and resold as new, whereas the automobile cannot. It is also evident that purchasers of automobiles who depend entirely upon their wages or salaries are mortgaging their future purchasing power. On account of these facts and many others, it seems probable that next year the production of passenger cars will fall between 2,700,000 and 3,300,000.

NOTE: The explanations in Chapter IX are not sufficiently detailed to enable the reader to understand the precise method applied. A seasonal movement is, by definition, a regular fluctuation occurring each year. There is disagreement among statisticians as to the logical possibility of securing indexes of seasonal variations that *change* each year. The data for 1910–23 are limited even for the determination of one set of seasonal indexes. — *Editors.*

CHAPTER X

FORECASTING BUILDING CONSTRUCTION

BY W. C. CLARK

THE problem of forecasting building construction in the United States may conceivably be approached from either one of two angles. In the first place, we may build up our forecast for the country as a whole by bringing together the results of a large number of local field surveys, or partial direct inquiries into building needs. Such local surveys are part of the normal work of the loan department of a large investment house, such as the one with which I am connected, which has specialized largely, though not wholly, in real-estate securities, and which has branches in all the large cities of this country. Consideration of an application for a loan on a modern fireproof apartment building, containing four-, five-, and six-room apartments and offering high-grade service, to be erected, say, in the Hyde Park district of Chicago, requires the most detailed knowledge of the present situation in regard to the need for that specific type of building in that specific section of that particular city, as well as the soundest judgment in regard to the manifold influences which may bring about changed conditions in the future. It is in such specific information about local conditions that real-estate loan analysts are primarily interested; and progressive investigation, whether by means of the formal field survey or the less formal daily contact with real-estate agents, building managers and others in first-hand touch with the facts, is continually being conducted to provide this essential factual equipment.

Brief reference may here be made to one of these studies, a recent inquiry into building conditions in Chicago. Fortunately, in the records of the Chicago Zoning Commission and of the Illinois Bell Telephone Company basic data are available which enabled this investigation to be carried out with greater exactitude than would be possible in many large cities. According to the Chicago Zoning Commission, there were in Chicago on January 1, 1922, 580,000 residence units. Deducting 14,233 residence units built in 1920 and 1921 and allowing for, say, 2200 demolished or destroyed by fire in these two years, we find that on January 1, 1920, there must have been about 567,967 residence units. According to the United States Census, the population of Chicago on January 1, 1920, was 2,701,705 persons, or 623,912 families. Therefore, it would appear that there were 55,945 (or, roughly, ten per cent) more families in Chicago than residence units. This, however, is probably an overestimate of the actual shortage. According to an elaborate investigation made by the Illinois Bell Telephone Company in 1920, there were living in lodging-houses, small hotels, and light-housekeeping rooms at that time, 18,358 families, and in large residential hotels, probably 4000 families, a total of 22,358. The remaining 33,587 families were presumably "doubling up."

The Telephone Company estimates that, of those families which were "doubling up," one half would occupy separate residence units, if units of the right type were available. According to our figures, therefore, 16,794 residence units were needed on January 1, 1920, for those who were "doubling up." This figure may be taken to represent the actual shortage on that date, if no allowance be made for normal vacancies.

With this figure as a basis, we can make a reasonably

accurate estimate of the situation to-day. According to the estimates of the United States Census, the population of Chicago increased, in 1920–23, by 210,833. Allowing 4.33 persons per family, there are, therefore, 48,691 more families in Chicago to-day than on January 1, 1920. This means a total of 672,603 families. Each year a certain number of residence units are torn down or destroyed by fire. While no definite figures are available, the following estimates for the last four years seem not unreasonable: 1920, 1000; 1921, 1200; 1922, 1800; 1923, 2300; total, 6300. Finally, allowance must be made for a normal number of vacancies. Records of the Telephone Company, confirmed by the experience of other public-utility companies and of real-estate firms, show that "there appears to exist a normal per cent of vacancy, which varies somewhat for different sections in Chicago, but which probably averages not less than four per cent for the entire city." The briefest consideration will show that some such percentage of vacancies should always be available, if tenants are not to be at the complete mercy of the landlords, and if there is to exist any flexibility at all in the selection of one's living quarters. It is also probably true that, at any given time, a certain percentage of existing residence units are practically unrentable because of wrong location, unsuitable type, or physical deterioration. If, therefore, we assume that, to provide normal conditions, there should exist residence units four per cent in excess of the number of families demanding them, we find that the number of surplus residence units to-day should be four per cent of 676,603, or 26,904.

Summing up, then, we find that in the last four years the following residence units should have been built: estimated shortage on January 1, 1920, 16,794; required by growth in population, 48,691; required to make up for

units demolished or burned, 6300; required to provide normal supply of vacancies, 26,904; total, 98,689.

The records of the Chicago Building Commissioner show that in the last four years, permits have been issued for the following residence units:

	1920	1921	1922	1923 Feb. to Dec. 12
One-family dwellings.......	1,826	4,608	6,390	7,863
Apartment units...........	1,091	6,708	18,125	23,768
	2,917	11,316	24,515	31,631
Total...............	1920–23			70,379

To this, should be added the increased number of families taken care of in residential hotels and lodging-houses since January 1, 1920, say, 2000; showing an apparent deficit of 26,310. With building even at its present unprecedented rate in Chicago, and allowing for the city's normal growth, it would take nearly one and a half years to make up this apparent deficit. This does not mean, of course, that the city may not already have caught up to the present demand for certain types of living accommodations or to the demand in certain districts. The foregoing study of building permits was therefore supplemented by a field survey which covered the more important buildings and real-estate agencies in the various residential sections of the city, and which was designed to secure information as to the supply of and demand for various classes of living accommodations in the different districts, the number of vacancies, and the trend of rentals. A study has also been made of the office-building situation in Chicago.

It is evident that if such local surveys were carried out in all sections of the country and in connection with all types of building, their results could be brought together in such a way as to give a comprehensive picture of con-

ditions in the industry as a whole and provide a sound basis for a forecast of future construction activity.

The second method of approach to the problem is to assemble the figures of building activity over as long a period as possible for as large a number of cities as possible, ascertain secular trend and seasonal variation, determine the correlation of the building cycle with the other indexes of general business activity, and project these factors into a future of reasonable length. Unfortunately, this phase of the work of my department has only recently been organized and our research is still in many cases in the initial or intermediate stages. I regret, therefore, that I have not many charts to present and that my conclusions are necessarily tentative and in part based on the published results of other studies as well as upon our own independent inquiries.

The difficulties which beset the application of this statistical method to the building industry are reasonably familiar to every statistician. There are, in the first place, the usual difficulties of inadequacy and inaccuracy of the crude data. In beginning our own study, we aimed at securing monthly figures for one hundred cities over a long period. We felt that neither the twenty cities used by most investigators nor the fifty cities used by Colonel L. P. Ayres[1] nor even the sixty-six city areas used by the Harvard Economic Service[2] provided an ample basis for the study of the industry as a whole. So great are the differences between geographical districts that the various sections of the country should be adequately represented. So great are the differences between the large and small

[1] *The Prospects for Building Construction in American Cities*, Cleveland Trust Company, June, 1922.

[2] "The Building Industry Since the Armistice," *Weekly Letter*, no. 29, vol. II, July 21, 1923.

cities — so important, for instance, to building has been the rural exodus to the large cities and more particularly the suburban movement in the last few years [1] — that the inclusion of leading cities only may lead to erroneous conclusions. We were, however, compelled to limit ourselves for the present to seventy-five cities and for monthly data to the period since January, 1909, though yearly data were in practically all cases secured back to 1900. Efforts are still being made through our National Building Survey to secure the missing data for the hundred cities and the earlier period. Incidentally, it may be mentioned that this Survey is now collecting the current permit figures for upwards of two hundred and seventy-five cities in all sections of the country.

Of the various indexes of building activity, it was decided to concentrate for the moment upon building permits. Architects' reports on projects contemplated are still far from adequate, though they forecast in a general way the future movement of building permits and contracts awarded.[2] Contracts awarded are not available for the entire country nor for any extensive period.[3] In any case, they seem to conform in general, though with a slight lag, to the seasonal, and cyclical fluctuation of building permits. The latter, it is true, have obvious defects. Buildings for which permits are granted may not be built.

[1] During 1923, twenty-five leading cities accounted for over forty-one per cent of the nation's building activities.

[2] See *Architectural Forum* and the *Building Bulletin* of the Brookmire Economic Service.

[3] Money values for twenty-seven Northeastern States have been published by F. W. Dodge Corporation, since 1910. Unfortunately, the six districts included in the report have been changed slightly from time to time. Since January, 1923, nine Southern States have been added and the total area now covered includes seven eighths of the population of continental United States. Since January 1, 1919, the figures for square feet of floor space represented by the contracts awarded have been published, classified by the different types of buildings.

Final costs may differ from the permit figures; in times of rising prices, they are apt to be too low, in times of depression, too high. The practice in regard to reporting costs varies with different cities and with different builders, even in normal times. Finally, inaccuracies in permit figures as published by the various reporting services are by no means infrequent. In some cases, three different figures were reported, by as many authorities, for a given city in a given month, and none was found to be in agreement with the reports obtained directly from the city itself. In many cases, also, it was difficult to reconcile monthly figures with the yearly totals. On the whole, however, permits serve our purpose best, and if sufficient care be used their inaccuracies can be reduced to a tolerable minimum.

Unfortunately, building permits are expressed in terms of value, and changing cost conditions undoubtedly obscure the real significance of their fluctuations. It was, therefore, necessary to eliminate the influence of varying cost of construction. No satisfactory index of general building cost is available. A number of the published indexes are satisfactory in a limited field (for example, the Aberthaw index in the case of reinforced concrete factory buildings); but in no case are they thoroughly reliable for the whole field of construction, and in many cases they are available for only a very limited period.[1] We have in

[1] (a) Aberthaw Construction Company's index of construction cost, available since 1914, compiled semi-annually from 1915 to May, 1921, and monthly since latter date. Based upon cost of constructing a seven-story reinforced concrete factory building in New England district in fall of 1914. Beginning with June, 1923, a similar index on a similar basis has been prepared by the Morton C. Tuttle Company.

(b) *Engineering News-Record's* index of general construction cost for country as a whole available by months since 1913. Based upon costs of steel (structural shapes, Pittsburgh base), cement (f.o.b., Chicago, exclusive of bags), lumber (Southern pine, New York base), and the rates paid com-

our own files a vast mass of data bearing upon the cost of construction of many different types of buildings in all sections of the country; and we purpose to develop ultimately an index number, or several index numbers, which will fill the gaps left by those already in the field. For the present we feel that we could do no better than follow the method, used by the Federal Reserve Bank of New York, of combining building material prices and building trades wages as reported by the United States Bureau of Labor Statistics in the ratio of 60 to 40.

The elimination of seasonal variation from the statistics of building permits is a comparatively simple matter. We applied the method of link-relatives used by Professor Persons to the data for the years 1909–22, inclusive, using the average of the three or four middle items instead of the median of each frequency table. We also adopted the Harvard method of using bi-monthly averages (January–February, March–April, etc.) instead of the figures for single months. The advantage of this device in smoothing out the very great month-to-month irregularities in the figures and in broadening the basis of the seasonal adjustment were so great that they could not be foregone. The pronounced seasonal variation to which building permits are subject is depicted in Figure 18. The average for the year is represented by 100. Beginning at the low point of 70.8 in the first two months of the year, building rises rapidly to 121.0 in March–April, remains practically stationary during May–June at 121.3, and

mon labor (in the steel industry through 1920, and after that averages reported by correspondents in about twenty cities.)

(c) Fuller Construction Company's index of hotel construction costs.

(d) Indexes prepared by the United States Department of Commerce, Bureau of Standards, Division of Building and Housing, and the Bureau of the Census, representing the relative cost of building materials entering into the construction of a six-room frame house and a six-room brick house. Based on 1913 and available by months since November, 1921.

then declines rapidly and almost steadily to 85.4 in the last two months of the year. Apparently, building costs are not subject to any regular seasonal variation. The broken line in the chart represents the seasonal fluctuations of building permits for the period 1919–23, after changes in building costs have been eliminated.

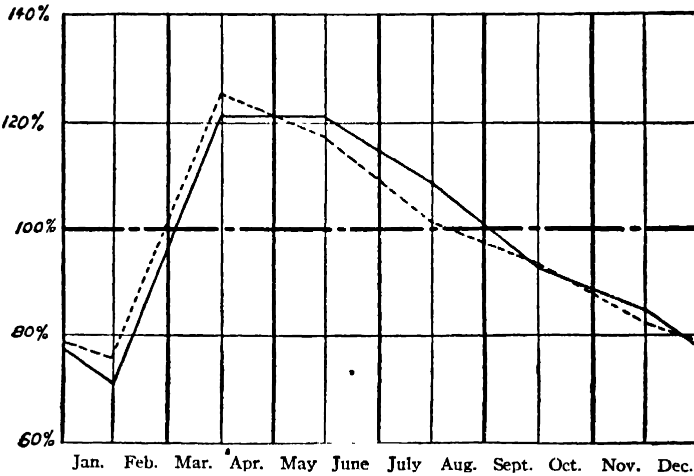


FIGURE 18. SEASONAL FLUCTUATIONS IN BUILDING PERMITS, 1919–23
Curve based on data from 1909–23 without price fluctuations eliminated ——; Curve based on data for 1919–23 with price fluctuations eliminated - - - - -

Two further theoretical considerations may here be mentioned:

(1) Seasonal variation in the building industry is probably changing, though up to the present the change has not been significant. Thanks to the breaking of traditions during the War, to the introduction of new methods of protecting materials, processes, and men, to better methods of job organization, and the realization of the great advantages of winter construction in keeping the contractor's organization intact, reducing seasonal unemployment, solving transportation difficulties, and

stabilizing the production of building materials, a determined effort is being made to spread construction activity more evenly throughout the year. Even in the North, winter construction is possible in many lines with little, if any, increase in cost. The suggestion has been made that the industry as a whole concentrate its activity to a greater extent in the South during the winter months. This and numerous other suggestions to reduce the heavy losses due to operation on the peak-load principle are to be canvassed thoroughly by the representative Committee which has been appointed recently by Secretary Hoover. We are planning to develop a moving average, or some other device (such, for instance, as that used by Mr. Prescott for the automobile industry) [1] which will take account of the gradual change in seasonal variation which we expect in the future.

(2) There are undoubtedly differences in the seasonal fluctuations of the industry in various geographical districts; and it is very likely that the regularization movement to which reference has just been made will progress with different rates of speed in each of these sections. It is, therefore, our belief that any adequate forecast for the building industry must be based on a separate study of seasonal influences (as well as of long-time trend) in geographic areas which are reasonably homogeneous from the standpoint of building activity. These geographic studies we have not as yet been able to make. A rather elaborate study of seasonal variations by geographic areas has, however, been completed by the Harvard Economic Service.[2] For this purpose, the twelve Federal Reserve districts were combined into six areas which, while not always wholly logical, yet do seem to possess a satisfactory degree of homogeneity from the

[1] See Chapter IX, above.

[2] *Weekly Letter*, July 21, 1923.

point of view of seasonal movements in building. The Eastern, the Atlantic, and the Western areas show a curve of seasonal variation substantially the same as our curve for the country as a whole. The curves for the Middle-Western, Southern, and Pacific groups, particularly the last, are much more flattened out. In the South, the peak of building seems to be reached in July instead of in April or May.

It is in the attempt to eliminate the influence of secular trend or long-time growth that the real difficulties confront the interpreter of building statistics. I am still uncertain as to whether it is possible to find any period, in the last twenty or twenty-five years, to the statistics of which the method of least squares may be applied for the calculation of a "normal" which might reasonably be applied to the industry at present or projected into the future for forecasting purposes. The difficulties and dangers involved in the choice of a period to which a line might be fitted are great. Obviously, the last five abnormal years furnish no reasonable basis for the calculation of a normal. The War years, moreover, cannot simply be left out of the reckoning, as is possible in many other statistical series. There is no reason why less than normal consumption of sugar or white bread during the War should mean a correspondingly greater than normal consumption of these products after the War. A shortage of building during the War does, however, mean that building after the War will be greater than normal, though to some slight extent the shortage which actually developed was doubtless made up by the use of buildings longer than they would have been used had there been no war. The building deficit of the War years, therefore, will affect the trend of building until that deficit has been fully made up. If it could be assumed that this deficit

was already fully or practically made up, it would be possible to calculate the long-time trend by fitting a line to the data for a long period, beginning, say, with 1900 or 1903 and continuing through the War period of under-building and the post-War period of abnormal building. That assumption is, however, a dangerous one; there is almost universal agreement that a large shortage of building facilities still exists.

The results of some experiments in calculating "normals" based on such periods may, however, be presented. If the figures for building permits for our seventy-five cities be corrected for seasonal variation as determined above, and for long-time trend, based on the period 1900–22, but not corrected for varying cost conditions, the adjusted curve will show building rising above normal in the latter half of 1919 and early 1920, then falling below normal, then rising again above normal about the middle of 1921, and remaining at an abnormally high level until the present moment. If, however, the factor of changing cost be eliminated, it will be found that, since the War, only in the last two months of 1922 and the first four months of 1923 has building been above normal — and even in this short period only slightly above normal. It is true, however, that 1900 was a year of low building activity and is, therefore, unfit for our initial year. If we choose the period 1903–16 (Figure 19), we find that after making the necessary adjustments for secular trend, seasonal variation and fluctuating costs, building did not reach a "normal" level until the middle of 1921; and the area above normal developed since that time is probably smaller than might be reasonably expected. In Figure 20, the line of long-time trend based on this period 1903–16, and also a similar line based on the period 1903–22, are fitted to the curves representing yearly and monthly

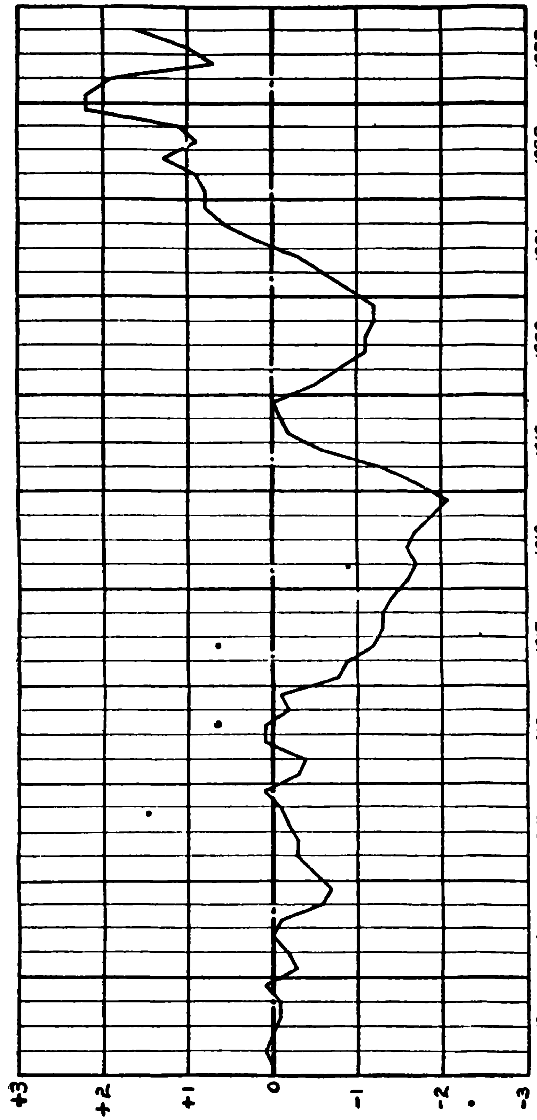


FIGURE 19. BUILDING PERMITS WITH SEASONAL FLUCTUATIONS, LONG-TIME TREND, AND CONSTRUCTION COST FLUCTUATIONS ELIMINATED

Standard deviations. Based on 75 leading cities, 1903–23; Long-time trend based on data, 1903–16.

data for building permits for over seventy-five cities. In neither case is the fit as close as might be desired. It will probably be found that a trend line appropriate for projection at the present moment would not slope upward as steeply as the 1903–16 line, and would doubtless have lower ordinates in the later years.

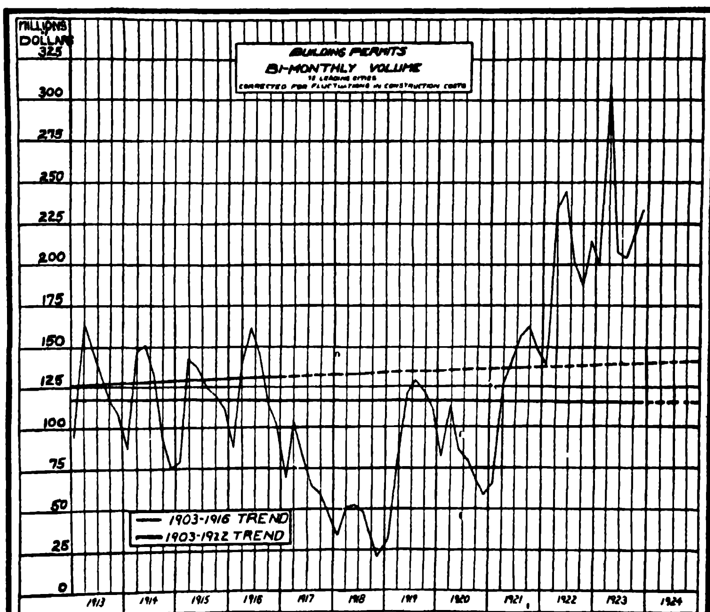


FIGURE 20A. BUILDING PERMITS: BI-MONTHLY DATA FOR 75 LEADING CITIES, CORRECTED FOR FLUCTUATIONS IN CONSTRUCTION COSTS, 1913–23
(From S. W. Straus and Company.)

There can be little doubt that the normal trend of the building industry has been changing in recent years. The effects of the accumulated War shortage of building facilities has already been referred to; this influence will probably continue for years to come. Numerous other

factors must, however, be taken into consideration. During the War years, for instance, immigration was practically cut off, and since the War it has been seriously restricted. Our population, therefore, has been growing probably at a less rapid rate in recent years than in the pre-War years. Certainly the increments of new population have included a smaller proportion of adults

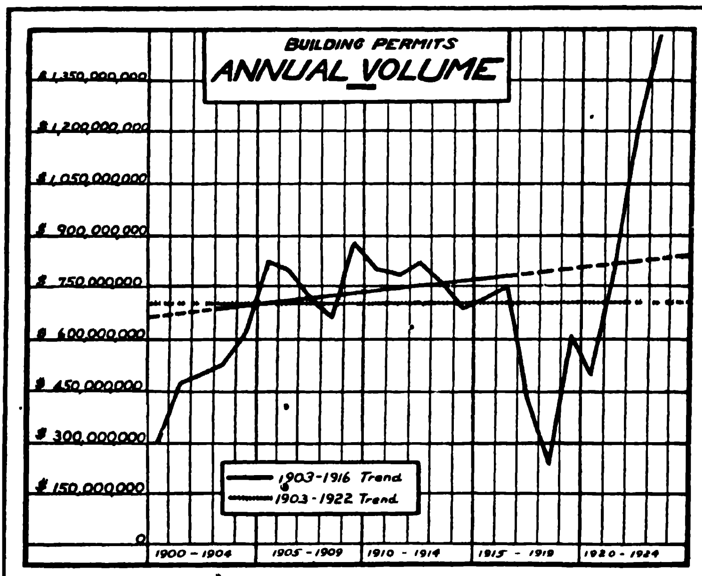


FIGURE 20B. BUILDING PERMITS: ANNUAL VOLUME, 1900–23
(From S. W. Straus and Company.)

than was formerly the case.[1] Of course, any increase in the birth-rate or any tendency to earlier marriages will tend to offset this influence, in part at least. Another factor of importance is the apparent fact that, whether as

[1] See argument of Willford I. King in *American Contractor*, September 15, 1923.

a result of our tendency to crowd into the cities or as a consequence of enforced economy due to high costs, we are tending to use less floor space per inhabitant than formerly. The vogue of the apartment house, and more particularly of the "kitchenette" or efficiency type of apartment and of the residential hotel, is sufficient proof of this tendency. To-day, also, we have the Montgomery Flagg house, which eliminates cellars and attics, and the two-room and three-room house which would have amazed a previous generation. Everywhere we find the utmost ingenuity being exercised by architects, engineers, and loan experts to the end that waste space in residences and apartment buildings, and even in office buildings, may be reduced to the minimum. These are tendencies which will continue.

These factors will tend to produce a trend line sloping downward. Working in the opposite direction will be found (1) the influence of the decreasing size of the family unit, and (2) the public demand for a better and better quality of accommodation. Evidonce of this latter tendency is found on every hand — for instance, in the demand for two or three baths, superior plumbing and electric fixtures, sleeping-porches, breakfast-rooms, garages, and all sorts of built-in equipment in the modern residence; and in the demand, in the modern office building, for rapid and convenient elevator service, toilet and washroom facilities, rest-rooms, libraries, lunchrooms, safety deposit vaults, and extensive quarters for an efficient administrative staff.

It is difficult at this moment to estimate just what the net resultant of these conflicting forces will be. As already suggested, the probability is that the trend in the future will be upward, though probably not as rapidly so as during the 1903–16 period. In this connection, it is

well to note that the building activity of the last few years has not been nearly so intense as we are wont to think. The magnitude of the building boom has been greatly exaggerated. Our judgment has been unduly affected by the intense activity in our largest cities, by the conspicuous nature of certain types of construction which are now in demand, and by the perpetual newspaper publicity given to special instances of high building-trades wages. We have forgotten that the recent activity has been centered primarily in our large cities and is by no means so conspicuous in the smaller towns. We have forgotten that, thanks to the heritage of expanded plant capacity left by the War, there has been less than normal building of industrial projects. We have forgotten that the modern apartment building is more conspicuous than the dozen or more houses which it is superseding, and that we have really no standards for judging normal activity in this comparatively new building field. Finally, we have forgotten that the strain of which the building industry has been showing evidence is due, not solely to the excessive demands upon it, but, in part at least, to its own depleted ranks. That the number of craftsmen in the building trades showed a relative decline in the decade 1910–20 is known to everybody; that the number in the building-trade unions in 1923 was lower than in 1920 is not so generally known, though such is the report which comes from the Building Trades Department of the American Federation of Labor. Doubtless the loss of workers may have been partly counterbalanced by greater use of machinery and by better organization; but that it has been fully offset cannot be affirmed with confidence.

As yet we have not been able to make any studies of long-time trend, plotting building permits against popu-

lation growth instead of solely against time. For the time being, we have accepted the results of the application of this method made by Dr. Ayres and Dr. King, but we believe that further research in this field would be fruitful. At least certain types of building (for example, residential, office, and educational buildings) must be a function of population growth.

If the determination of the normal must, for the time at least, remain something of an unsolved puzzle, there is less difficulty with and less controversy over the general problem of correlation. On whatever basis secular trend be eliminated, the curve for building permits, corrected also for seasonal and construction cost fluctuations, can be correlated with other indexes of the cyclical swings of business activity. Moreover, the correlation which is illustrated by the data for the last five years is substantially the same as that which has been established for pre-War years. Generally speaking, building permits tend to move early in the business cycle. In the downward swings of the cycle, they anticipate the turning points in general business, while in the upward swings they may precede, coincide or follow, depending on special conditions in the construction industry itself. In the 1904–07 cycle, for example, building permits began to rise eight months in advance of the upswing in general business; in the 1908–10 cycle, they recovered at about the same time in the spring of 1908; and, in the succeeding cycle, they lagged about two months behind the general movement. On the downward movements of each of these three cycles, the building industry anticipated the decline in business by some two to six months. For the years 1919–23 our building data for seventy-five cities have been plotted against the Harvard B Curve, the Harvard A Curve, the curve for building costs and the

curve for interest rates on four to six months' paper.[1] The dominating influence of the construction industry in this period is readily apparent. Thanks to the pressure of the accumulated shortage of building facilities, it has taken the lead in both of the expansion periods since the Armistice. In 1919 it began to recover immediately, practically

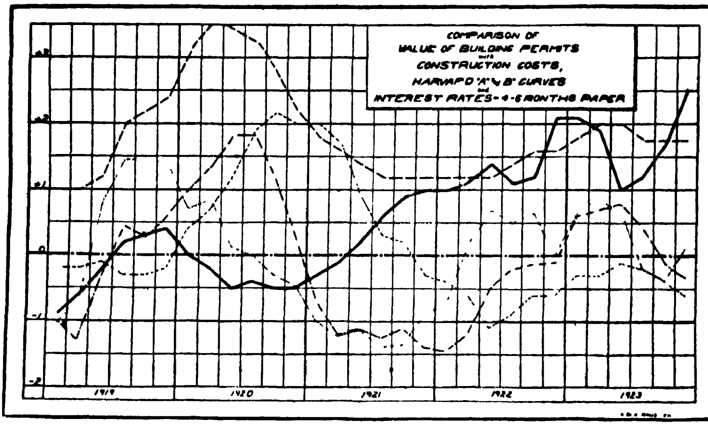


FIGURE 21. COMPARISON OF VALUE OF BUILDING PERMITS WITH CONSTRUCTION COSTS, HARVARD "A" AND "B" CURVES, AND INTEREST RATES, 4–6 MONTHS PAPER, FOR 1919–23; IN STANDARD DEVIATIONS

Building Permits ——; Building Construction Costs – – –; Harvard Speculative "A" Curve......; Harvard Business "B" Curve —·—·—·—; Interest Rates, 4–6 Months Paper -----

("Building Construction Costs" scale is twice that of the other series.) (From S. W. Straus and Company.)

as soon as speculation, preceding business by about two or three months. It also was the first to feel the evil effects of the unsound business situation which developed later in the year. Permits reached their peak in November–December of 1919, and declined sharply, fully eight months before the recession in business and almost contemporaneously with speculation. The pressure to make

[1] The data for building permits are in terms of a 1920–21 bi-monthly average as a base.

good the War shortage of buildings was, however, too great for the industry to remain long depressed in spite of the high level of costs. In the second two-months period of 1921, therefore, building again began to pick up, a full year before the Harvard B Curve indicated a recovery in general business, and even eight or nine months before the Harvard A Curve bore witness to returning confidence in the stock markets. The building recovery, while at first gradual, was nevertheless persistent and soon brought the industry to a high level of activity in 1922. As activity continued and the successive deferment of the hopes of those who expected an early reduction in building costs ultimately brought acquiescence in the prevailing level of costs, the movement gained momentum. The intense activity which prevailed last winter and early spring with its effect on building material prices and building wages is familiar to all. Familiar, also, is the sequel — the March recommendation of Secretary Hoover that the Government initiate no new construction work except that urgently necessary, and the subsequent action of the governors of the American Construction Council recommending that all new construction be deferred for several months ahd that the financing of speculative building be curtailed until after the end of the summer. This advice, coming at a time when business caution and misgiving as to the general soundness of the whole economic situation were widely prevalent, brought a sharp decline in permits. The June building figures were lower than at any time for many months, and the inference was drawn by a number of observers that the building cycle which began in 1920 had now culminated after the customary duration of about three to three and a half years. As the figures for later months of the year became available, however, they seemed to lend no sup-

port to the exponents of this point of view, the recovery of building in October and November being little short of remarkable. It is clear that the rather close correspondence between building and general business which was found to exist in the pre-War years has characterized conditions since the War, with this single difference, that in all cases in the later period the building industry has anticipated general business expansion. Indeed it has probably been a major factor in stimulating that expansion.

The general inverse correlation between building costs and building permits is very close but is only what would be expected. More striking is the almost perfect inverse correlation between building permits and interest rates on four to six months paper. The decline in interest rates after the Armistice is followed by the recovery in building at the beginning of 1919. With interest rates on a low level, building continues active until November–December, 1919, when interest rates turn upward and building downward. Rising interest rates are accompanied by a low volume of building until interest rates begin to turn downward in September–October, 1920. Two months, later, building recovers and maintains an increasing rate of activity during a long period of low and falling interest rates. The rise of interest rates in May–June, 1922, is accompanied by a decline in building; a check to this rise in September–October, 1922, coincides with a rapid upward movement in building, and a further rise in November–December, 1922, is followed at an interval of two months by the beginning of an important downward swing in building. In May–June of this year interest rates reached their peak and have since declined, while the building industry reached a low point from which recovery has been rapid.

Interesting results have also been obtained by corre-

lating the square-foot areas of the different classes of buildings for which contracts have been let with the indexes of general business conditions.[1] Since January, 1919, such figures are available in the records of the F. W. Dodge Corporation. Examination of these figures for the short period which they cover seems to show that residential buildings follow a definite cyclical trend and anticipate the movements of the various other classes of buildings, the total volume of construction and indeed most of the indexes of general business activity. Mercantile and industrial construction follow the cyclical fluctuations of total construction and coincide rather closely with general business. The curve for the construction of public works and public utilities follows a more erratic course, reflecting undoubtedly the influence of the growing tendency of public officials to let contracts for public works when the labor market is more or less seriously depressed. While these results are very interesting, it is doubtful whether the period covered is long enough to warrant definite conclusions. The forecasting characteristic of residential building in this recent period, for instance, may possibly be due to the fact that the shortage accumulated during the War years was, as we know, primarily a shortage of residential facilities.

In conclusion, a word as to the outlook for 1924. In the first place, I wish to say that I find myself in disagreement with the position assumed by Dr. King who maintains[2] that most of the estimates of building shortage have been exaggerated and that "there is no conclusive evidence that anything in the nature of an unsatisfied

[1] See article by Willford I. King in *American Contractor*, July 21, 1923, and the *Graphic Review* published by F. W. Dodge Corporation, October, 1923.

[2] *American Contractor*, September 15, 1923.

demand for building exists at the present time." Doubtless there has been exaggeration. I believe, however, that the estimate of the accumulated deficit made by Dr. L. P. Ayres was not greatly in excess of the real facts, though his study is doubtless subject to the criticism made by Dr. King in regard to failure to take account of the influence of declining immigration and subject, also, I think, to the criticism that his "normal" is based on a period which began with a year of abnormally low building and ended with a year of relatively high activity. Holding as I do, that the estimates of the accumulated shortage have not been greatly exaggerated and knowing the tendency to magnify the physical volume of construction which has emerged in the last four or five years, I believe that the shortage has not yet by any means been made up, and that for a number of years to come it will exert a powerful influence upon the building industry and upon general business.

Recent developments seem to offer conclusive testimony to the soundness of this point of view. The remarkable recovery of permits in the last three months of 1923 cannot be fully explained without the assumption of a large continuing demand for new construction. The existence of such a demand finds further confirmation in our own local investigations and in the files on contemplated projects in the offices of leading architects. During the five months ending with November, 1923, the monthly average of contemplated construction was more than double that for the same period in 1922. This fact alone would lead us to expect an increase in demand next year from the agricultural sections where, as a result of the agricultural depression, practically no building has been going on and possibly, also, a slight increase for industrial construction in certain lines. The decline in build-

ing permits which took place during the summer is, therefore, to be explained not as a major turning point in the industry but rather as a result of the deliberate efforts made to prevent certain excesses which for a time threatened to endanger the soundness of the entire industry. The results of these efforts were largely beneficial; they eased the tense situation in the building labor and building materials markets and brought construction cost to a level which makes for greater permanence.

The continued ease in the money market is another factor which permits a favorable forecast for the immediate future. Interest rates have been declining since the fall recovery in building was initiated. The return to the owners of new buildings is still generous, for the most part. Rents are still high and promise to be stabilized at something around present levels. A report of the National Association of Real Estate Boards as of November first shows that out of 241 cities to which a questionnaire was directed, ten per cent of those replying reported residential rents down as compared with forty-four per cent last year, fifty per cent reported stationary conditions as compared with twenty-two per cent last year, and forty per cent reported an upward tendency as compared with thirty-four per cent last year. Confidence in the stability of prices on substantially the present level for the next few years is also probably more generally diffused than at any time since the War. Finally, there is no adequate basis in the general business situation to warrant alarm as to the building outlook for 1924. It is true, of course, that a serious decline in business activity would be reflected in the building industry. But a sane appraisal of the facts now at the disposal of the business forecaster leads only to the conclusion that 1924 is to be a year of moderately high activity. Practically all the experts are

agreed as to the favorable outlook for the first half of the year and many maintain that in the absence of untoward developments in Europe and in domestic politics, a further recovery in business is to be expected in the later months of the year. To no inconsiderable extent, the relatively high level of activity which is predicted for 1924 will be stimulated and sustained by the demands of the building industry, just as moderately good business will help to support the building industry, chiefly through the maintenance of general confidence.

In brief, then, the outlook for 1924 is for a year of high building activity, a year in which the industry will be kept working to something like capacity, but a year also which will be characterized by greater stability and fewer of those excesses which marked the opening months of 1923.

CHAPTER XI

AVAILABLE BUILDING STATISTICS

By WILSON COMPTON

FORECASTING presupposes knowledge. Prediction of the future must be based upon the experience in the past. If the experience is reliably described in the statistical evidence, and if the forecast is based on an accurate analysis thereof, the inevitable result will be in the direction of greater stability.

This is of particular consequence in the building industry where forecasting seems to be a popular national pastime, although too frequently based on shrewd guessing rather than upon analysis of the statistics of past experience. But there is probably no industry in which forecasting of the future has a greater bearing on the activity of the present than in construction and its related industries. Generally speaking, new construction is not a matter of the immediate day's necessity. It is frequently identified with the agricultural and garment industries under the catch-phrase of "food, clothing, and shelter." But this identification is, in at least one important respect, inaccurate and unsound. Eating food and wearing clothing are not subject to deferment with a view, under a forecast, to lower prices later on. Ordinary building, however, is readily susceptible to such deferment. Hence the importance of reasonable stability in construction costs and construction activity. Hence the importance of the construction forecast. Hence the importance of the statistical information necessary to reliability in the forecast.

Reliable information on the contemplated *volume* of

construction is more readily available than equally reliable information on the prospective *costs*, including labor, materials, and supplies. I make no mention of building-trades wage forecasts nor of costs of supplies and miscellaneous equipment used in construction. The remaining factor is the cost of basic building materials, such as lumber, cement, brick, tile, stone, and slate. Ten years ago, information on the production and consumption of these materials was available ordinarily at intervals only of one year. So-called current trade information was comparatively unknown. To-day current information with respect to the changes in the supply and demand and price of most of these materials is publicly available. The Department of Commerce, through the Bureau of the Census and through its Division of Building and Housing, has contributed greatly to the public availability and public use of this information. It is drawn regularly from well-organized sources within the industries and trades themselves. Unless misguided prosecuting officers succeed by injunctions in closing up these sources of reliable trade information in the trade associations of these industries, this flow of information will become even more regular and more comprehensive and reliable. It is one of the fundamental bases of accurate construction forecast.

For example, in the lumber industry there are twelve regional associations of lumber manufacturers. These represent different commercial species. There is a National Association, representing all of these regional groups. Among its active functions is that of promoting uniformity in method and comparability in practice of the current statistics compiled and published by each, as representing the current changes in supply and demand for lumber and, in some instances, the prices received.

The National Lumber Manufacturers Association procures each week by wire the record of exact production, shipments, and new business received, from approximately five hundred identical and representative sawmills distributed throughout the country. It publishes this information weekly, first, through the newspapers, the trade press, and the press agencies; second, through its weekly "barometric" report on lumber movement; and third, through agencies of the Government and those of other interested industries. It publishes reports of changes in unsold or unshipped lumber stocks at producing points. It shows comparisons of the current week with the preceding week, the preceding month and the preceding year. These comparative statistics are published to members and non-members, buyers and sellers, producers and consumers, and at the same time. The lumber association also publishes weekly comparative statistics showing the wholesale prices received at the sawmills for basic items of construction lumber. This price information is furnished to the lumber-using and general public only. None of it is furnished to the lumber manufacturers themselves.

Here, then, is a specific example of a well-organized and systematic public service in the current statistics of changes in lumber supply, lumber demand, and wholesale lumber prices at the sources of production. This service is used by two hundred and fifty newspapers; summarized in press association dispatches; published in numerous trade journals; utilized by statistical and economic services and by banks and agencies of the Government. Five years ago no similar information based on exact facts was available from any source whatsoever.

This reference to lumber statistics is illustrative only. Other building material industries have similar, though

perhaps less nearly complete, services. It signifies the progress made by basic industries in an important and comparatively new field of effort in the direction of industrial stabilization. Their practical economic importance and their bearing upon stable conditions of business organization and conduct have been repeatedly and convincingly disclosed during the past few years.

One other contribution to stability in the construction industry deserves passing comment. Industries generally do not reach their highest stage of economic perfection until the sizes, dimensions and qualities of their basic products and their methods of manufacture and distribution have become standardized. Industrial standardization is a practical method of waste elimination. Standardization and simplification have received tremendous impetus and inspiration from the present Secretary of Commerce, who has calculated that the elimination of preventable wastes in American industries would result in national savings equivalent to the entire costs of government — Federal, State, and local. The construction industries would be especially benefited by the standardization of sizes and grades of basic building materials and by the simplification of types of construction and architectural design. The lumber industry, representing the largest single material factor in construction, has recently accomplished, as a result of five years' organized effort, a national standardization of lumber sizes and lumber grades likely to result eventually in savings to the building public and the industry of tens, if not hundreds, of millions of dollars annually. Standardization of materials will inevitably result in production of a larger proportion of staples and a smaller proportion of specialties. This feature alone means a vast contribution to the stabilization of production, a result which is impossible

where production is largely on special orders. But standardization is impossible without the aid of reliable statistics of production, distribution and consumption.

Organized statistical service in basic building material industries, therefore, contributes to construction stabilization in two distinct ways. First, it is essential to reliable forecast of building costs; second, it makes possible the intelligent simplification and standardization of sizes and qualities, which in turn tends to make staples out of what previously had been specialties, and inevitably tends toward greater uniformity in quality and toward lower costs of basic construction materials. The first of these two is the more obvious. But the second, through its bearing upon industrial standardization and resultant savings and greater stability, is, in the long run, I believe, the more important.

DISCUSSION BY JOHN M. GRIES

THOSE who forecast carloadings can, within a few months, check their forecast with the actual number of cars loaded. It is also possible to forecast production, shipments, and sales figures for a certain period and at a later date check the forecast against actual results. In this way it is possible to correct errors and refine the methods of forecasting so that more accurate predictions may be made in the future.

Many individuals and agencies attempt to forecast building construction for several months in advance, and most of these forecasts are predicated on the value of building permits or contracts awarded. As a rule, these forecasts are predictions of future "building activity." Not having a measure or unit for "building activity," we are unable to check predictions against results. Probably the best measure of building activity is the

number of men in the building trades actually employed, or the retail sales of building materials such as brick, lumber, and cement which as a rule become an integral part of the structure within three weeks after being delivered on the job. If building activity means actual work on the job, then we have never had figures in this country with which to check forecasts.

Work on architects' boards, value of building permits issued, and value of contracts awarded are three rough indicators of how much building we may expect in the future. Work on architects' boards precedes the letting of contracts or the issuance of permits. If architects would agree on a uniform method of computing the cubical contents of a building, and some method should be provided for collecting these data from a large number of architects, I believe we should have an earlier indication of what we might expect in the way of new construction than anything we now have. This, however, is not enough. It is only the first rough sign of approaching building activity. To postpone building is easy as long as the project has progressed no further than the architects' boards. This may indicate little more than the state of mind of prospective builders, but there may be a certain correlation with actual building. A peak in the work of architects, interpreted in the light of business cycles, would probably throw some light on future building activity. If the downward swing of the business cycle was about to begin, the actual building would probably be delayed for months or years; but if the movement was starting upward, prompt building might be expected to follow. Statistics of this kind would cover only a small part of the work, but it would serve as a worth-while sample.

The value of building permits issued is widely used in forecasting construction. Figures of this kind are far

more valuable in connection with cyclical studies than with seasonal studies. Since there is no necessity of building after a permit has been taken out, permits are often taken out freely after there has been a decided drop in actual activity. Building permits appear to be a far better guide for the long-time swing than for the shorter movements. In fact they are often misleading, especially just before a marked fall in business conditions.

Building permits as now used have several weak spots. At the present time there are many prominent, private agencies which report monthly value of building permits issued in a large number of cities. Comparisons of these reports often reveal wide differences in values for a city, ranging at times to more than thirty per cent. In some cases different values have been reported for a given city by each of four agencies. Then, too, the value of permits issued is usually accepted by the layman as presented, without any correction fot the change in the value of the dollar. Both cubical contents and floor space are better units for measuring construction, but such figures do not accompany permit figures. Another weakness in permit figures is that the valuation is not made on the one hundred per cent basis. The cost or fee for a permit as a rule is based on the estimated cost of the building. It is possible to place the valuation as low as sixty per cent of actual cost, or it may be placed as high as one hundred per cent. The range is rather wide within a given city and between different cities.

Building permits do not measure activity on the job. As a rule, in normal times, buildings are started shortly after the permit is issued, but there are many delays. If a depression is approaching, no action is taken on many permits granted; and on many, action may be delayed for months or years. The lag between actual construc-

tion and the granting of the permit varies with the season of the year and with our position in the business cycle. From sample studies, the lag appears to be much shorter in the later spring and early summer than it is in the winter months. At certain stages of the curve, actual building starts promptly after the issuances of permits; at other periods, the delay is much longer. Again, if a city plans to revise its building code, it often follows that many permits are issued to those who fear that the new code may be much more stringent. They want to get in under the old regulations. The same thing happens when the city authorities plan to adopt zoning regulations. Examples may be found where only a small percentage of the permits taken out at such time were built upon within the next twelve months.

While permits are an unsatisfactory index for volume, they can be made to show the trend over a long period. If permit figures for our cities were more nearly complete, and reports were more nearly uniform, much could be learned from these figures. If the reports would clearly indicate the kind of buildings — wood, brick, hollow tile, concrete, steel frame, etc., the total floor space, or the cubical contents, the number of apartments or rooms, the number of single family houses, etc., building permits would take on an added value. The facts reported should be such that building permit statistics would not only show the trend of construction, but would enable the producer and vendor of building materials to forecast his production and sales. It should also be possible to determine more accurately our housing needs, and the direction our housing problem is taking.[1] The financier should also be able to obtain the information he needs. Why cannot all the agencies now collecting permit figures join

[1] Chapter X deals with these problems.

hands and secure uniform reports, so that all parties will be served and thereby avoid duplication of work, and at the same time better serve all groups?

What specific information can the brick producer obtain from building permits? What do mere valuation figures mean to the lumber dealer? What do they mean to those who fabricate steel? What does the housing expert

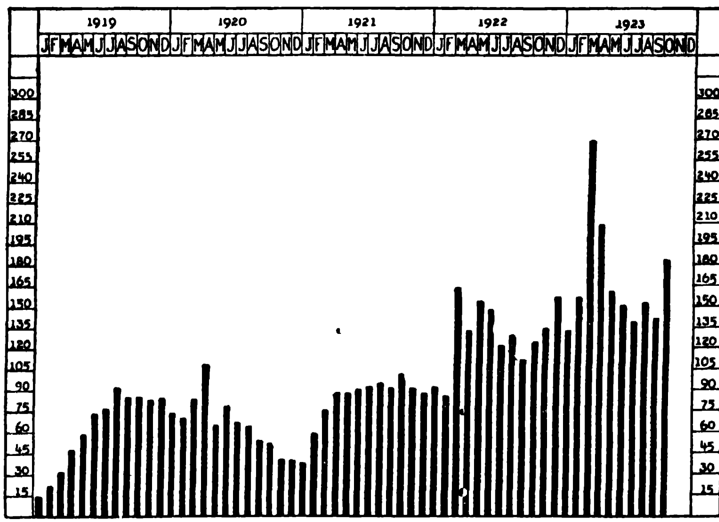


FIGURE 22. VALUE IN MILLIONS OF DOLLARS OF BUILDING PERMITS ISSUED IN 20 LARGE CITIES, 1919–23
(From United States Department of Commerce, Bureau of Standards)

learn about the shift now taking place towards more apartment house construction? What does he learn about the increase in "walk-ups"? If we are to continue using building permits, let us improve the form of reports and the substance as well. We seem to be so busy using the figures that we have not spent enough time in reëxamining our facts.

During the summer of 1923 the statement was re-

peatedly made that there was a marked drop in building activity. This, to my mind, was a very misleading statement. Figure 22 shows valuation of building permits issued in twenty large cities. It does show a great drop in building permits; but does it show a decline in building activity? Reports covering most of the large cities showed that building trades labor in most of the crafts was just as busy during June, July, and August as it was during May. In fact the indications are that it was busier. Bonuses were paid during this period in many cities. Curves showing the retail sales of lumber, brick, and cement indicate a greater activity on the job than during the earlier months. It seems conclusive that the contractors could not take on more work, considering the supply of labor and their equipment, and for that reason contracts were not taken. But a failure to take out permits or to award contracts does not necessarily mean that building activity slowed up.

From the foregoing short outline, we can readily see the many disadvantages in predicating future construction activity on the valuation of permits issued. Over a long period, building permits have a certain value; and, if certain changes were made in the form of reporting them, they would be useful in many ways. The construction industry needs to encourage the collection of better basic data, so that it will be possible to forecast construction activity in such a way that it will benefit not only the producer and vendor of lumber, brick, cement, lime, plumbing fixtures, heating equipment, builders' hardware, window glass, sash and doors, but also those other closely connected industries which furnish and equip the buildings produced by the construction industry.

CHAPTER XII

FLUCTUATIONS IN MINERAL OUTPUT

By GEORGE OTIS SMITH and Others[1]

For the last ten years the mineral industry has been acutely conscious of violent fluctuations both in the demand for its products and in the prices offered for them. Many of us who have watched this industry are a bit incredulous as to the conclusion of the economist that these fluctuations in demand and price are largely caused by recurring waves of general prosperity and general depression, and that we may hope, by patient efforts, if not to prevent these recurring booms and slumps, at least to minimize their ill effects. We have got into the habit of connecting the extremes of activity and stagnation with the Great War and what we have thought to be the reaction after the War. In the bituminous coal industry, a still different set of circumstances — the recurring strikes with their attendant shortages and panic prices — has claimed our attention to the exclusion of the possible effects of any general condition of business.

The War and its immense effects were impressed so vividly upon mining men that you will pardon us if we still believe that the greatest single factor in the extraordinary prosperity of the mining industry from 1915 to 1918 was the War and, conversely, that the greatest factor in the depression of 1921 and 1922 was also the War. Almost overnight we discovered a large class of

[1] The "others," who hold a majority interest in this paper, are F. G. Tryon, F. J. Katz, A. H. Horton, E. F. Burchard, G. B. Richardson, and C. E. Siebenthal.

minerals, or at least we learned to call some old acquaintances by a new name — War minerals. The revolutionary changes in commodity prices caused by the War were, of course, common to all business, but the prices of minerals were affected to a peculiar degree. The prices of the metals used in the making of munitions began to rise early in 1915, fully six months before there was any material advance in the general level of prices, and they rose to a higher level than the price of any other class of commodities. Another class of commodities, however, responded to the War demand even more quickly, for the price of chemicals began to jump the moment the British blockade tightened in on Germany, and among the chemicals there are many products, such as sulphuric acid and benzol, toluol, and other derivatives of coal that we of the mining industry group with the minerals. Other minerals were in demand for the manufacture of munitions, but the customary overseas source of supplies of these was now cut off. To this group of essential materials, ordinarily but little mined in the United States because our deposits of them happen to be limited or of low grade, belong manganese, chromite, antimony, magnesite, mica, and graphite. The Armistice found us with a large family of infant mineral industries that held varying expectations of life.

At the peak of 1917, the price of the metals stood at about three and a fourth times the pre-War level. This enormous increase in price resulted in a great expansion of mining facilities and reduction plants. The capacity thus created could not be fully employed in peace-times, even when business was active. The declaration of peace, therefore, brought an inevitable reaction, which was intensified by the fact that the warring nations had accumulated a great surplus stock of metals. To find a

market for their surplus products under peace conditions, the metal miners turned to extensive educational and advertising campaigns to find new uses for familiar materials. "Make it of zinc" and similar slogans were adopted by trade committees.

Examination of the forty-year record of mineral output, however, shows that there were recurring periods of prosperity and adversity long before this War, and that the same factors that caused these pre-War fluctuations were also at work during the boom of the War itself and during the subsequent reaction. No one in the coal industry has forgotten the condition of the operators in the Middle West in 1914, when mines representing twenty-five per cent of the total capacity in Illinois were in the hands of receivers; and the present overproduction of petroleum finds its counterpart in the sudden development of the Cushing field in April, 1914. A vast flood of oil thrown upon the market at a time when general business was depressed even drowned the effect of the European War which cut off supplies of Russian petroleum, and the slump in prices which resulted was without precedent in the history of the industry. The effect of the panics of 1893 and 1907–08 may be read in the production curve for iron, lead, and zinc. The losses suffered by the mining industry from periodic waves of depression justify the most earnest search for causes and for some way to control the business cycle. The reference here made to the dominant influence of the War in the events of the last ten years is intended not to divert attention from the business cycle but to point out that in the mining industry, particularly, the War introduced complications which may make the behavior of the industry as it emerges from its recent depression quite different from its behavior under earlier depressions that were less severe.

Indexes of mineral production

Thanks to Professors Day, Stewart, and others, we now have available indexes of the physical volume of production, not only of mining, but of agriculture, manufacture, transportation, and of all industries. A diagram by Professor Day (Figure 23 [1]) shows how much more rapidly the

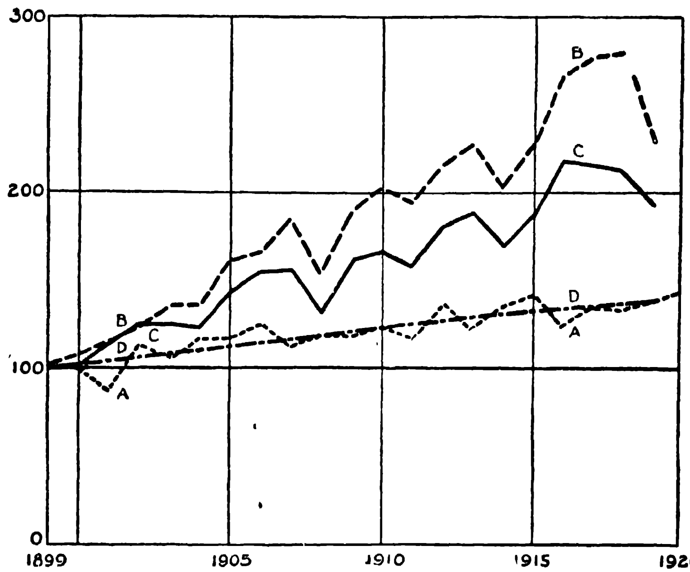


FIGURE 23. UNADJUSTED INDEXES OF PHYSICAL PRODUCTION FOR (A) AGRICULTURE, 1899–1920; (B) MINING, 1899–1919; (C) MANUFACTURE, 1899–1919; (D) POPULATION, 1899–1919

(Items for 1899=100; Data from Harvard Economic Service.)

mineral output of the country has been increasing than that of either agriculture or manufacture. From 1899 to 1919, while the population increased only forty per cent, the output of manufactured goods roughly doubled, but the output of the mines and quarries of the country much

[1] Reproduced from the *Review of Economic Statistics*, 1920.

more than doubled. The mineral curve expresses increments in civilization as well as increases in population. Agriculture, in the mean time, was barely keeping pace with the growth of population. This extraordinary increase in the quantity of mineral wealth withdrawn from the earth not merely raises social questions as to how these limited resources may best be developed and utilized, but also introduces peculiar complications in the interpretation of the figures. To determine how much of the increase in a year of active business is due to the tone of business, and how much to some technical change such as that discussed by Dr. Pogue in Chapter XIV, below, or to some newly discovered facts about the underground supplies available, is a matter of consequence to the statisticians who would use the record of mineral output as a business indicator. We have not completed the task when we have drawn alongside the curve a straight line which may accurately represent the trend of production thus far. The resources underground set certain limits to the future output of minerals which do not apply to the output of most manufacturing industries. Careful study, such as the oil men have given to the future life of existing oil properties, by which it is possible to predict with considerable accuracy the curve of output for a given well or a given pool when once its nature is understood, will no doubt greatly improve the usefulness of the statistics of mineral output as a barometer of business.

It is doubtful whether an index of production of all minerals is of great significance to one who is watching the current changes in business. While all mining has in common the great fact of dealing with a wasting resource — a fact which creates in this industry unique problems not shared by other industries — it does not follow that the several minerals will be affected at the same

time or in the same degree by the changes of the business cycle.

Their output does not fluctuate simultaneously, and a certain mineral may be much less affected by the course of some other mineral than by the course of a manufactured product for which it is used. It is clear that there are at least five groups which may move independently of one another. The fortunes of the ferrous metals group, including alloys and non-metallic associates — that is, manganese and chrome, zinc for galvanizing, coke for fuel, magnesite for refactory linings — are bound up in the iron and steel industry and fluctuate with the output of pig-iron. The non-ferrous metals are affected by some influences in common, such as the demand for munitions and electrical equipment, but they have other and peculiar uses. The fluctuations of the fertilizer group follow the lead of agriculture and are at the moment profoundly influenced by the uncertainty of supplies of potash from Germany whence, before the War, our entire supply was derived. If some one will start an index of the manufacture of sulphuric acid, he will furnish a significant and useful business barometer, for this material, half mineral and half manufactured product, is so omnipresent in industry that its market must respond to any change in the general conditions of business. The building materials group, including clay products, brick, tile, cement, lime, gypsum, and the like, commodities on the border-line between mining and manufacture, follows the course of construction industry and may, as in 1918 and 1921, move in just the opposite direction from the metals. Coal and petroleum likewise have habits of their own which lead them in different paths from many other minerals.

There are now several current monthly index numbers of mineral production issued by the Federal Reserve

Board, the Department of Commerce, and the Harvard Review of Economic Statistics. All these organizations find difficulty in giving proper weight to iron, in determining its economic gravity. Because pig-iron controls, in whole or in part, the demand for so many other minerals, no index of mineral production is complete without it; but to include pig-iron, and at the same time to include the coke and the coal that go to make it, is obviously to count double, and where this kind of counting is done, the mineral index is overdominated by the fluctuations in iron and steel. The Department of Commerce index attempts to get around this difficulty by using, instead of pig-iron, the monthly shipments of iron ore on the Great Lakes, but the assumptions underlying this substitution, namely, that the ore is mined at the same time it is shipped, and that the twenty per cent of the output that comes from other districts and does not move "by Lake" fluctuates in the same ratio, are subject to challenge. The index would probably be more consistent if it used pig-iron as a measure of the smelter output of iron, just as copper blister is used as the measure of the output of copper, and the danger of double counting through including both the raw material and the product can be met by weighting the index, not by the total value of the product but only by the added value over and above the cost of materials of which it is made.

Business barometers among the minerals

The primary aim of this paper is not, however, to measure the growth of the mineral industry, but to examine the several mineral commodities for which current statistical data are now available, and to see which of them are the most sensitive and significant business indicators.

The diversity among the several members of the mineral group is so great that an index of mineral production in the aggregate is not a true barometer of business. To find such a barometer, we must rather take up the individual mineral products and trace their courses during a period of time long enough to determine their characteristic reaction to the ups and downs of business. For this purpose, the annual figures heretofore published by the Geological Survey are not sufficient. We have therefore prepared statistics of the monthly output of nine of the minerals of largest commercial consequence back to the years 1912 or 1911, to be shown here as a series of figures in which the form of presentation is the same throughout.

Pig-iron

The familiar curve for pig-iron (Figure 24[1]) illustrates the form we have selected for presenting the data. The diagram is in two parts. The upper part shows two curves. The zigzag curve represents the output of pig-iron for each month, beginning with January, 1911. In order to avoid the small and meaningless fluctuations caused by the difference in the lengths of the months — fluctuations that produce a downward jog in every February and an upward jump in every March — we have plotted here the average daily output, which is expressed not in tons but in terms of an index number, that is, a percentage of the daily average for the five-year period 1909–13.

Why we have used this index number will appear from a consideration of the second curve in the upper part of the diagram. This curve — represented by the straight

[1] Data on monthly and average daily output of pig-iron quoted from *Iron Trade Review*, November 29, 1923, p. 1510. Index numbers calculated by the United States Geological Survey. Average daily output for five years, 1909–13, amounting to 74,123 gross tons = 100.0.

broken line — represents the volume of manufactured goods produced during the year, as worked out by Professor Day.[1] It is introduced here to supply a correction for the factor of growth from year to year, which is present

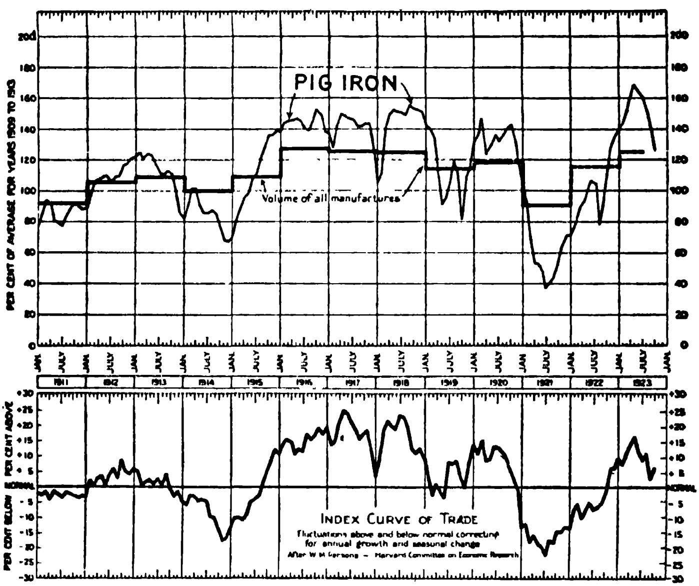


FIGURE 24. PRODUCTION OF PIG-IRON AS A BUSINESS INDICATOR

(In Figures 24–32 inclusive, various production indexes are compared with the volume of trade index, prepared by Warren M. Persons for the Harvard Committee on Economic Research. The index curve of trade shows fluctuations from normal with corrections for annual growth and seasonal change.)

in most curves representing business activity. The volume of manufactures represents, perhaps as well as any other one thing, the gross trend for the country as a whole. It is independent of change in prices, and its rate of increase is midway between that of agriculture, which increases but slowly, and that of mining, which increases more rapidly. The curve for pig-iron has not been cor-

[1] *Review of Economic Statistics*, 1920, p. 336.

rected in any way, but some idea of how much of the upward tendency in that curve is due simply to growth, rather than business changes, may be seen from the form of the broken line, the curve for all manufactures.

The lower part of the diagram shows the index of trade, published currently by the Harvard Committee on Economic Research.[1] This index is a composite of all types of business activity — manufacturing, mining, transportation, and banking. This index is corrected for growth from year to year, and for seasonal change, so that the curve here shown represents the departure from normal. When the curve rises above the line of normal, business is active; when it falls below that line, business is dull, and the distance it reaches above or below the normal line measures roughly the intensity of the activity, or the depth of the depression. Beginning with the business flurry of 1911, the curve is slightly below the normal line. It rises to represent moderate activity in 1912, and falls in the latter part of 1913 into the depression of 1914 and 1915. That depression gains momentum with the outbreak of the European War, but begins to disappear in 1915 as the flood of munition orders flows in from the Allies. From that point on, the curve shows the activity of the War period. The sudden but temporary drop in the winter of 1917–18 represents the traffic congestion and coal shortage of that period, conditions which we now know were associated with the jamming of our ports and terminal facilities with goods for Europe. Other familiar landmarks in the curve are the lull following the Armistice, the revival of mid-1919, the downward jog associated with the steel and coal strikes of November, 1919; the activity of 1920, and finally the great depression of 1921 from which the country did not emerge till late in 1923.

[1] *Review of Economic Statistics*, April, 1923, p. 71.

Comparison of the index of trade with the curve of pig-iron above shows again how sensitive a barometer pig-iron is. If we may set it down as a mineral, in company with copper, zinc, and the like, it is probably the most useful of the available mineral barometers. The record runs over periods so long that the behavior of the curve is well known. The seasonal irregularity is slight, and the output is seldom affected by external causes such as strikes.

Some danger arises from this very sensitiveness of the pig-iron curve: it may exaggerate the extent of a business change. It is clear that the fluctuations in output of iron from low to high and back again are much wider than the fluctuations for all business.

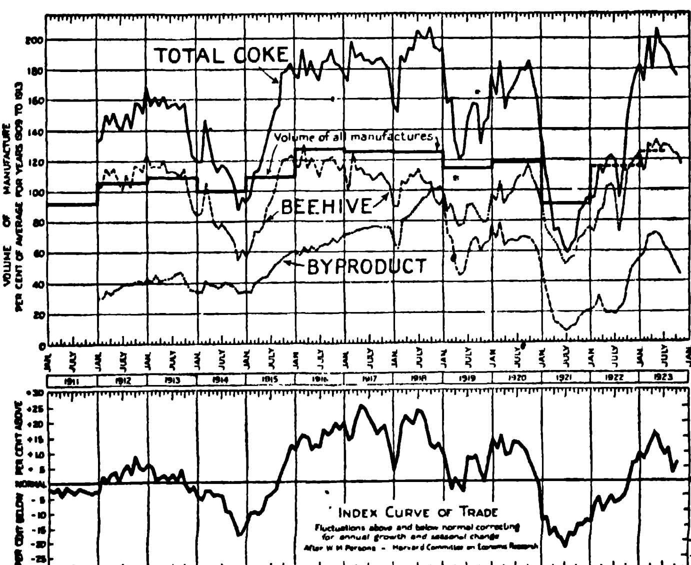


FIGURE 25. COKE AS A BUSINESS INDICATOR

(The scales are the same as in Figure 24, except that curves of coke production represent total tons produced each month.)

Coke

The curve of coke output (Figure 25[1]) closely follows the curve for pig-iron. It is here shown on the same background as the others of this series. The data are derived from the monthly reports of the Geological Survey, and those for the pre-War years are here shown for the first time. The heavy black zigzag line represents the total output of all coke — beehive and by-product. The lighter dash line represents beehive coke and the dotted line represents by-product coke. It shows the familiar fact that by the increase in capacity of by-product ovens, by-product has been gradually substituted for beehive coke. The by-product curve crossed the beehive curve

TABLE 19. ESTIMATED MONTHLY PRODUCTION OF BEEHIVE COKE IN THE UNITED STATES, 1912–14, IN NET TONS

Data for Connellsville region are monthly shipments as reported by the Connellsville *Courier*. For other regions the output has been estimated from reports to the Geological Survey of monthly shipments over the principal coke-carrying roads. Monthly figures are adjusted to total output for the year.

Statistics for 1915–21 will be found on page 378 of United States Geological Survey report, *Coke and By-products in 1921*, and for 1922 and 1923, in the Survey's weekly coal reports.

MONTH	1912	1913	1914
January	2,553,000	3,124,000	2,105,000
February	2,589,000	2,880,000	2,137,000
March	2,879,000	2,910,000	2,653,000
April	2,771,000	2,896,000	2,343,000
May	2,884,000	3,001,000	1,993,000
June	2,657,000	2,807,000	1,890,000
July	2,538,000	2,833,000	1,977,000
August	2,778,000	2,810,000	1,888,000
September	2,573,000	2,750,000	1,793,000
October	2,941,000	2,870,000	1,665,000
November	2,895,000	2,500,000	1,363,000
December	2,810,000	2,204,000	1,529,000
	32,868,000	33,585,000	23,336,000

[1] Data in Tables 19, 20, and 21.

in November, 1918. As the beehive industry has now become a sort of auxiliary supplying only that part of the coke required which cannot be furnished by the by-product ovens, it deserves study as a supersensitive indicator of the iron industry. Note the peculiar peak in the beehive curve just before the coal strike of 1922 and the slump thereafter which marks the sympathetic strike of the non-union workers in the Connellsville region. A downward jog in the curve of by-product and of pig-iron in August and September, 1922, shows that a coal strike is not merely a matter of inconvenience, but has a serious reaction on business. It is not simply a factor of risk and unsettlement, but it may on occasion actually limit the volume of production in other industries. (See Tables 19, 20, and 21.)

TABLE 20. MONTHLY PRODUCTION OF BY-PRODUCT COKE IN THE UNITED STATES, 1912–16, IN NET TONS

These figures are based upon reports to the United States Geological Survey from practically all companies, with estimates for those not reporting. Monthly totals are adjusted to agree with published figures for the year as a whole.

Statistics for 1917–21 will be found on page 378 of the Geological Survey report, *Coke and By-products in 1921*, and for 1922 and 1923, in the Survey's weekly coal reports.

MONTH	1912	1913	1914	1915	1916
January....	778,000	1,081,000	898,000	858,000	1,506,000
February..	778,000	1,030,000	853,000	844,000	1,449,000
March.....	878,000	1,132,000	1,032,000	971,000	1,564,000
April..	845,000	1,030,000	987,000	1,027,000	1,506,000
May......	900,000	1,055,000	976,000	1,084,000	1,583,000
June..	923,000	1,068,000	920,000	1,098,000	1,526,000
July.......	967,000	1,094,000	954,000	1,196,000	1,583,000
August.....	1,000,000	1,144,000	1,010,000	1,281,000	1,621,000
September..	978,000	1,119,000	976,000	1,337,000	1,621,000
October....	1,023,000	1,093,000	942,000	1,421,000	1,716,000
November..	1,056,000	992,000	830,000	1,450,000	1,659,000
December..	989,000	877,000	842,000	1,506,000	1,735,000
	11,115,000	12,715,000	11,220,000	14,073,000	19,069,000

Table 21. Estimated Monthly Production of all Coke, Beehive and By-product, in the United States, 1912–23

Prepared by F. G. Tryon, of the United States Geological Survey, from reports of producers and railroad shipments. Figures represent *thousands* of net tons

Month	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923[a]
January......	3,331	4,205	3,003	2,304	4,425	4,711	3,894	4,811	4,372	3,347	2,415	**4,578**
February.....	3,367	3,910	2,990	2,427	4,336	4,297	3,759	3,920	4,048	2,742	2,386	**4,292**
March	3,757	4,042	3,685	2,836	4,827	4,952	4,680	3,999	4,622	2,335	2,918	**5,505**
April........	3,616	3,926	3,330	2,868	4,381	4,673	4,593	3,302	3,846	1,836	2,770	**4,982**
May.........	3,784	4,056	2,969	3,020	4,627	4,740	4,849	3,007	4,071	1,879	3,009	**5,157**
June.........	3,580	3,875	2,810	3,308	4,444	4,635	4,793	3,078	4,170	1,629	3,085	**4,921**
July.........	3,505	3,927	2,931	3,541	4,304	4,636	5,123	3,701	4,324	1,467	2,977	**4,849**
August.......	3,778	3,954	2,898	3,834	4,620	4,565	5,016	3,947	4,491	1,621	2,389	**4,733**
September....	3,551	3,869	2,769	3,919	4,637	4,646	4,983	3,904	4,475	1,702	2,898	**4,485**
October......	3,964	3,963	2,607	4,450	4,795	4,678	5,168	3,252	4,631	2,138	3,747	**4,389**
November....	3,951	3,492	2,193	4,475	4,593	4,577	4,844	3,600	4,284	2,231	4,145	
December ...	3,799	3,081	2,371	4,599	4,544	4,497	4,777	3,660	4,011	2,361	4,385	
	43,983	46,300	34,556	41,581	54,533	55,607	56,479	44,181	51,345	25,288	37,124	

[a] Subject to revision.

Cement

The most notable feature of the curve showing production of cement (Figure 26 [1]) is the wide seasonal variation. Except for this great seasonal change, which makes

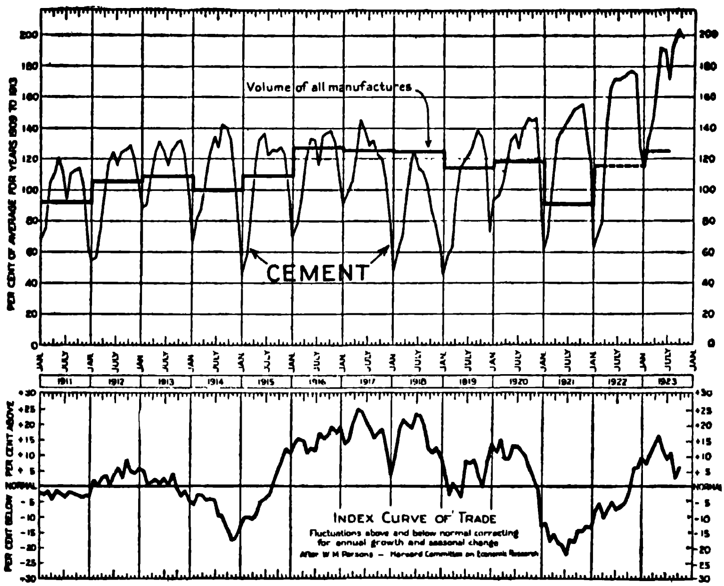


FIGURE 26. CEMENT AS A BUSINESS INDICATOR

(The scales are the same as in Figure 24 The statistics for cement represent average daily production for each month expressed in per cent of the daily average for the five-year period, 1909–13.)

it somewhat difficult to interpret during the winter and early spring, the cement curve should be a useful barometer of business. It reflects, of course, the activity of construction, particularly road-making. For this reason the cement industry was relatively depressed in 1918, when construction had to yield priority to the manufacture of War materials, into which cement did not enter in

[1] Data for 1911–20 in Table 22. Data for 1921–23 from United States Geological Survey monthly reports on cement production.

large volume. Conversely, when other industries were feeling the great depression of 1921 the cement mills were making new records. It is encouraging to note that the output for October, 1923, the last month shown, was the largest in the history of the industry.

Cement-making is also interesting as one of the few industries in which figures for producers' stocks are available over a long period. The demand for cement is even more seasonal than the production, as here shown. Shipments during the winter drop far below the low point of production and in like manner, during the summer, rise above the high point of production. The curve for stocks is the reverse of the curve for shipments.

These statistics for the years 1920–23 are the current monthly statements of the Geological Survey. For 1911–19 they have been compiled by E. F. Burchard, of the Survey, from data furnished by the Portland Cement Association. The original data, representing companies that produced about eighty-five to ninety-five per cent of the total output, have been adjusted to equal the total for the year, as ascertained by the annual statistical canvass by the Survey. (See Table 22.)

Petroleum

The output of petroleum (Figure 27 [1]) is, of all the minerals, the least sensitive to business cycles. Measures to restrict production do not become effective in the pipeline runs of oil, which measure output, until many months after they are initiated. Thus the petroleum curve shows little sign of the depression of late 1920 and early 1921 until the month of September, 1921. The curve presents few landmarks, but its entire course is a landmark in itself. No curve for the other minerals shown can be com-

[1] Data from annual reports of United States Geological Survey.

TABLE 22. TOTAL PRODUCTION, SHIPMENTS AND STOCKS OF PORTLAND CEMENT IN THE UNITED STATES BY MONTHS, 1911–20

Representing from ninety-three to ninety-nine per cent of the production, with estimates for the plants not reporting to the Portland Cement Association. Stocks represent condition at end of month.

The figures of stocks, even including estimates for missing plants, do not tie in exactly with the Survey's published figures of total stocks as of December 31st, each year, but the discrepancy between the two series of figures is small, and the monthly series is comparable throughout.

(Unit: one thousand barrels)

	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1911													
Production	4,610	4,618	6,986	7,187	8,034	7,307	6,370	7,460	7,352	7,742	6,717	4,294	78,677
Shipments	2,332	3,254	6,394	6,407	8,116	7,280	7,349	9,183	8,611	7,934	5,252	3,376	75,548
Stocks	10,782	11,842	12,503	13,129	13,154	12,298	11,459	9,696	8,383	8,280	9,723	9,895	10,386[a]
1912													
Production	3,746	3,577	5,015	6,432	7,885	8,085	7,834	8,314	8,178	8,696	7,842	6,871	82,475
Shipments	2,210	2,849	5,161	7,441	8,281	8,726	9,093	10,258	9,136	9,876	7,512	4,470	85,013
Stocks	12,083	12,787	12,693	11,700	11,275	10,827	9,507	7,437	6,541	5,302	5,707	8,069	7,811[a]
1913													
Production	5,958	5,495	7,392	8,198	8,854	8,122	7,769	8,449	8,539	8,882	7,987	6,452	92,097
Shipments	3,403	3,798	6,895	7,920	9,077	8,831	9,202	10,109	10,159	9,049	6,272	3,974	88,689
Stocks	10,636	12,237	12,511	12,879	12,506	11,694	10,225	8,433	6,770	6,593	8,307	10,583	11,220[a]
1914													
Production	4,502	4,939	5,898	7,027	8,320	8,487	8,553	9,535	9,179	8,923	7,494	5,373	88,230
Shipments	3,274	3,354	5,679	7,368	9,150	9,826	9,831	10,465	9,858	9,354	5,655	2,624	86,438
Stocks	11,770	12,301	13,559	13,192	12,372	11,106	9,955	9,011	8,397	7,959	9,848	12,547	12,773[a]

[a] Stocks on December 31, as given in annual reports of United States Geological Survey.

TABLE 22. TOTAL PRODUCTION, SHIPMENTS AND STOCKS OF PORTLAND CEMENT IN THE UNITED STATES BY MONTHS, 1911–20 (*continued*)

	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1915													
Production	3,147	3,507	5,808	7,809	8,936	8,868	8,193	8,471	8,129	8,543	8,025	6,479	85,915
Shipments	2,994	3,348	6,298	7,554	8,291	9,556	8,877	9,015	9,555	9,312	7,540	4,553	86,892
Stocks	12,405	12,532	12,084	12,298	12,919	12,213	11,502	11,000	9,604	8,861	9,329	11,331	11,463[a]
1916													
Production	4,767	4,931	6,156	7,865	8,931	8,623	7,807	8,738	8,893	9,274	8,474	7,062	91,521
Shipments	2,950	3,593	5,940	8,086	9,680	9,266	8,577	10,752	11,558	10,809	8,061	5,280	94,552
Stocks	13,030	14,340	14,613	14,355	13,560	12,944	12,196	10,214	7,464	5,922	6,350	8,187	8,361[a]
1917													
Production	6,155	5,958	7,097	8,613	9,789	9,025	8,628	8,870	8,025	8,076	7,003	5,575	92,814
Shipments	3,597	3,681	6,969	8,954	10,985	9,041	8,556	9,429	9,499	9,176	6,687	4,129	90,703
Stocks	10,747	13,033	13,160	12,808	11,614	11,602	11,683	11,133	9,668	8,563	8,886	10,330	10,354[a]
1918													
Production	3,284	3,722	4,704	6,400	7,744	7,974	7,643	7,512	6,738	5,966	5,106	4,289	71,082
Shipments	2,258	2,800	5,365	8,706	8,277	8,812	7,051	7,338	7,050	6,266	4,197	2,796	70,916
Stocks	11,357	12,277	11,594	9,271	8,694	7,824	8,391	8,542	8,201	7,888	8,780	10,265	10,451[a]
1919													
Production	3,089	3,536	4,583	6,274	7,604	7,756	8,303	8,719	9,022	9,088	7,862	4,942	80,778
Shipments	2,035	2,494	4,245	6,247	7,222	8,322	9,057	9,725	11,980	10,768	8,013	5,505	85,613
Stocks	11,266	12,275	12,495	12,473	12,779	12,138	11,303	10,216	7,160	5,393	5,150	5,055	5,257[a]
1920													
Production	6,304	6,104	7,075	7,788	8,906	8,881	8,571	9,491	9,504	10,366	9,468	7,565	100,023
Shipments	3,877	4,002	6,503	7,750	8,676	10,264	11,306	10,713	10,874	10,956	7,806	3,385	96,312
Stocks	7,502	9,611	10,183	10,199	10,424	9,034	6,092	4,882	3,509	2,914	4,570	8,721	8,941[a]

pared with it in rapidity of increase. Some of the factors in that increase are discussed by Dr. Pogue in Chapter XIV, below. Petroleum, therefore, while so big an element in business as to be worth watching of itself, is not a good indicator of other business.

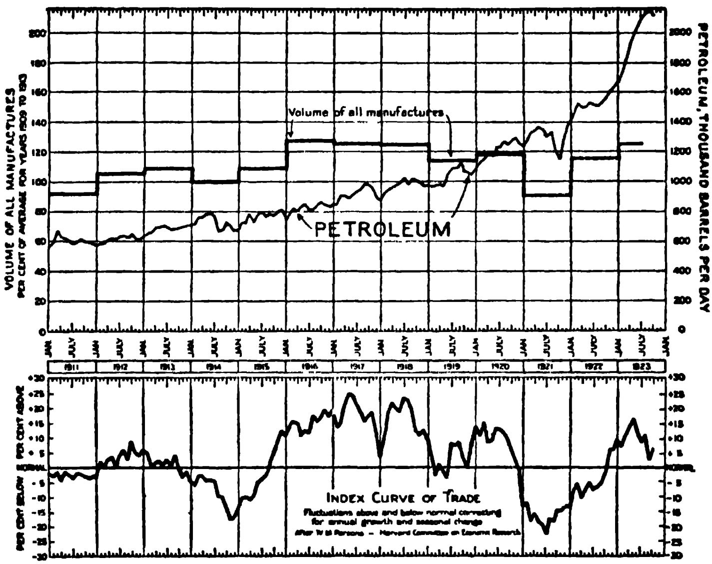


FIGURE 27. PETROLEUM AS A BUSINESS INDICATOR

(The scales are the same as in Figure 24 except that the figures for petroleum represent the number of barrels produced per day. Statistics for petroleum prior to 1919 represent "marketed production" which sometimes differed widely from the actual production, especially during 1914 and 1915.)

Zinc

The intensity of the War stimulus and the corresponding intensity of the post-War reaction are shown by the course of zinc production. (Figure 28 [1].) The outbreak of

[1] For 1911–16, inclusive, and 1919, only half-yearly data are available; see United States Geological Survey annual reports, *Mineral Resources of the United States*. For 1917 and 1918, monthly data may be found in United States Geological Survey report, *Zinc in 1918*, p. 1030. The monthly figures of the American Zinc Institute began with 1920.

the European War brought an immediate rise in the price of American spelter.

While other commodities were passing through the depression of 1914–15, shown by the index of trade in the

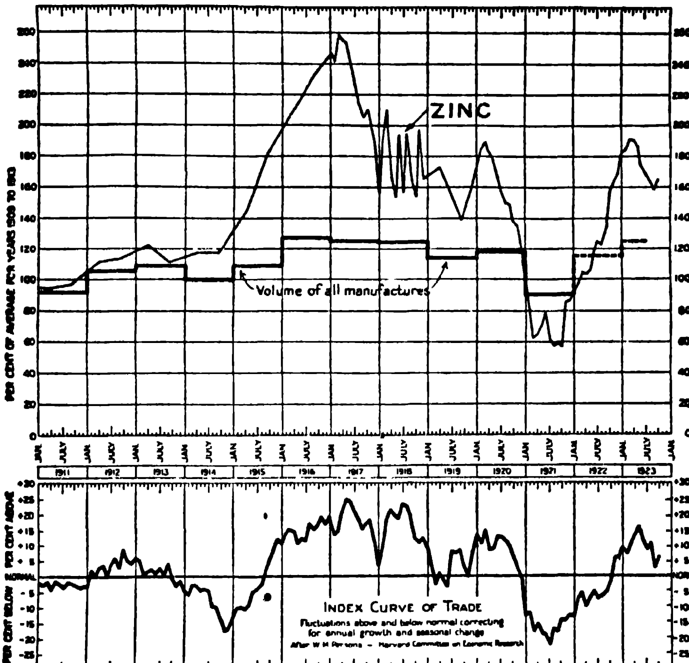


FIGURE 28. ZINC AS A BUSINESS INDICATOR

(The scales are the same as in Figure 24. The statistics for zinc represent the average daily output for each month expressed in per cent of the daily average for the five years, 1909–13. Data for 1917 to 1920, from *Engineering and Mining Journal;* for 1921 to 1923, from American Bureau of Metal Statistics, in both cases prorating to agree with United States Geological Survey annual canvass. No monthly data prior to 1917.)

lower diagram, the output of zinc increased rapidly to more than double the pre-War output. But the very prosperity brought about by the War contained the seeds of depression. It called into being a world surplus of mining and smelting capacity, so that business for the

zinc producers was dull in 1919 and 1920 and extremely depressed in 1921.

Monthly statistics of zinc production are not available for years prior to 1917. The trend, however, is sufficiently indicated by the half-yearly reports of the Geological Survey. Beginning with 1920, the American Zinc Institute began to collect monthly statistics which it publishes widely and which promise to be a valuable indicator of general business.

Copper

The curve for copper (smelter production) (Figure 29 [1]) reveals much the same influences that are shown by the curve for zinc. No doubt there was a cycle of business which was one element in the peak of copper output in 1917–18 and the canyon of 1921, but both were greatly exaggerated, if not created, by the demand for munitions and the subsequent reaction. Iron and steel, sensitive to all the changes of business, show a less extreme range between high and low than the ten-year curve of copper. If allowance is made for this fact, it is clear that copper offers an excellent business indicator, one that deserves more careful study than it has yet received. Data on monthly output and stocks at both smelters and refineries should be collected for the pre-War period and correlated with changes in general business. At present only fragmentary monthly records are available prior to 1917, and for some periods since then the record is imperfect.

[1] Prior to 1917, only annual data are available on smelter output of copper. Monthly data for 1917–20, published by *Engineering and Mining Journal*, are here adjusted to equal total for the year as reported by United States Geological Survey. Monthly data for 1921–23 furnished by American Bureau of Metal Statistics to Department of Commerce, figures for 1921 and 1922 being adjusted to equal total for the year as reported by the Survey.

The producers of copper can help to stabilize American business by arranging to publish currently and promptly full statistics of their production, shipments, and stocks.

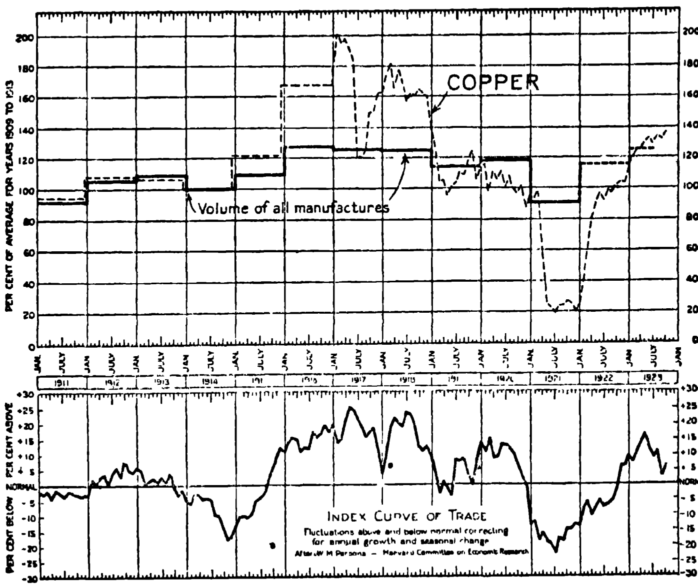


FIGURE 29. COPPER AS A BUSINESS INDICATOR

(The scales are the same as in Figure 24. The statistics for copper represent the average daily smelter output for each month, expressed in per cent of the daily average for the five years, 1909–13.)

Lead

The current statistical record of lead available to the public is inadequate.

Anthracite

Anthracite, though fourth among the mineral industries in value of product and second only to bituminous coal in number of employees, is of little significance as an indicator of general business. The consumption is

domestic and inelastic, and the depression of 1921 was not reflected in the anthracite curve (Figure 30 [1]) until about a year had passed and then only for a short interval.

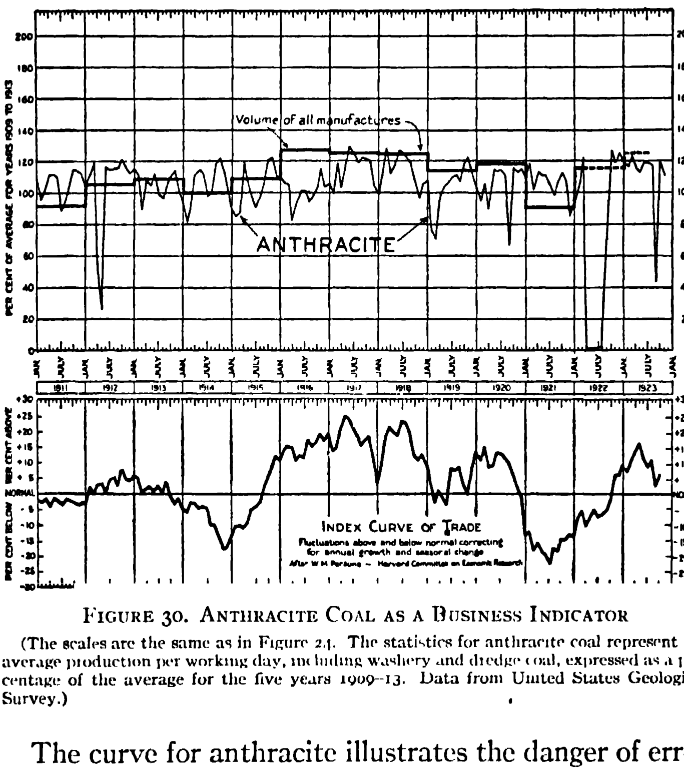


FIGURE 30. ANTHRACITE COAL AS A BUSINESS INDICATOR

(The scales are the same as in Figure 24. The statistics for anthracite coal represent the average production per working day, including washery and dredge coal, expressed as a percentage of the average for the five years 1909–13. Data from United States Geological Survey.)

The curve for anthracite illustrates the danger of error in attempting to compute "long-time trend" by formulas applied to past production records. It is true that the curve of *total production*, including culm-bank washery and river coal, shows a fairly steady increase up to 1918, but to project that increase onward to get a standard by which to measure the actual production of, say, 1923,

[1] Data in Table 23.

would be to ignore the limits of increase set by reserve underground, colliery capacity, labor supply, and other factors. The facts are that it now takes practically full time operation of the anthracite mines to supply the current demand, and that even at the present rate the coal in the ground will last barely a hundred years. (See Table 23.)

TABLE 23. ESTIMATED MONTHLY PRODUCTION OF PENNSYLVANIA ANTHRACITE AND AVERAGE PRODUCTION PER WORKING DAY. 1911–12, IN NET TONS

Based on monthly shipments as reported by Anthracite Bureau of Information, and includes mine fuel, local sales, washery and dredge coal, and output of Sullivan County.

Statistics for 1913–21 are on page 465 of United States Geological Survey report, *Coal in 1921*, and for 1922 and 1923 in the Survey's weekly coal reports.

Month	1911		1912	
	Total	Daily average	Total	Daily average
January	7,635,000	305,000	7,644,000	294,000
February	6,558,000	273,000	7,793,000	312,000
March	7,755,000	287,000	8,713,000	335,000
April	7,507,000	313,000	354,000	14,000
May	8,170,000	314,000	1,896,000	73,000
June	8,038,000	309,000	8,211,000	328,000
July	6,213,000	249,000	8,335,000	321,000
August	7,154,000	265,000	8,722,000	323,000
September	7,411,000	296,000	7,793,000	325,000
October	8,107,000	324,000	8,840,000	340,000
November	8,008,000	320,000	8,177,000	327,000
December	7,908,000	316,000	7,884,000	315,000
	90,464,000	298,000	84,362,000	276,000

Bituminous coal

Soft coal (Figure 31 [1]), on the other hand, is chiefly an industrial fuel and is very greatly influenced by the busi-

[1] Data presented in *The Bituminous Coal Industry in Prosperity and Depression*, by David L. Wing and F. G. Tryon.

ness cycle. The *consumption* of soft coal is probably as good a measure as any of the activity of business as a whole, because it is used in all industries, even in refining petroleum. But the *production* of soft coal for a given month, or even a year, may be a very different thing from the *consumption* because of the movement of coal in and

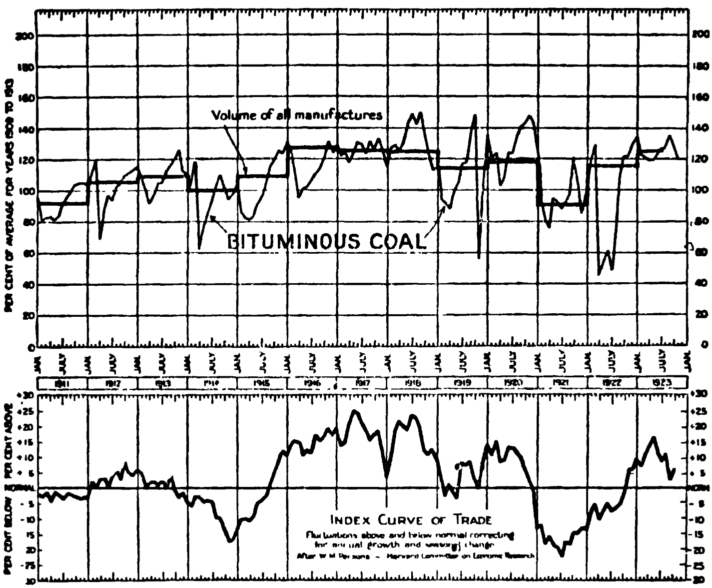


FIGURE 31. BITUMINOUS COAL AS A BUSINESS INDICATOR
(The scales are the same as in Figure 24. The statistics for bituminous coal represent the average production per working day, expressed as a per cent of the average for 1909–13. Data from United States Geological Survey.)

out of consumers' storage. In 1918, for example, some 40,000,000 tons flowed into storage; the next year it flowed out again, so that the decline in consumption from 1918 to 1919 was not twenty per cent, as would be indicated by the figures showing production, but only about nine per cent.

Furthermore, the recurrent strikes introduced into the

coal curve an element that has no immediate relation to business cycles. The enormous peak in October, 1919, represented buying for storage in anticipation of a general strike of the union miners, and the chasm of the following month, though it was a cause of decreased production in other business, was not a measure of the decrease.

When we learn enough about seasonal variations in the consumption of coal, and when we have continuing records of coal stocks, coal will furnish us a barometer of great value. In the meantime it is suggestive, not conclusive.

Electric power production

The Geological Survey has been greatly interested in the figures for the output of electric power at public utility central stations.[1] These statistics have been collected by the Survey since 1919, and it is clear that they offer one of the most sensitive and valuable of business indicators.

In the first place, electric power faithfully reflects all business, and the proportion of it which is used for lighting gives a not disproportionate weight to the home life of the people. About fifty per cent of the production is used by industries, about thirty per cent by electric railways, and about twenty per cent for lighting. The curve is nowhere distorted by storage. The production of power is simultaneous with its consumption, and the production curve is actually a consumption curve. Furthermore, the curve is not affected by ordinary strikes and external factors such as car supply, except when interruptions in the receipt of fuel may continue long enough to exhaust the supply of stored coal and thus force the

[1] Data from monthly reports of United States Geological Survey on Production of Electric Power and Consumption of Fuel by Public Utility Power Plants.

plants to curtail their output. Electric public-utility plants carry sufficient coal in storage to supply their needs for one or two months, and an interruption in the supply of one of the basic commodities of industry for one or two months will affect business as a whole and will, of course, be indicated by a decline in the production of electricity by public-utility plants.

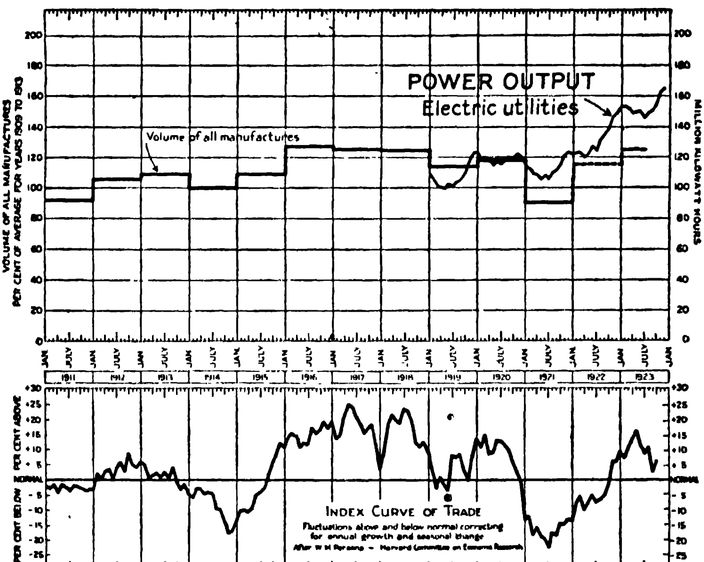


FIGURE 32. ELECTRIC POWER PRODUCTION BY CENTRAL STATIONS AS A BUSINESS INDICATOR

(The scales are the same as in Figure 24, except that the curve of power output represents daily production in K.W.H. Data from *Electrical World* and United States Geological Survey.)

Figure 32 shows the average daily output in million kilowatt hours for each month, beginning with January, 1919. To use the curve as a business indicator it must first be corrected for growth and for seasonal variation. It represents not the output of power at all steam or

hydro-electric installations, but only that at public-utility plants. The use of electrical power is increasing by leaps and bounds, but it is not growing as fast as the public-utility production of power because every month

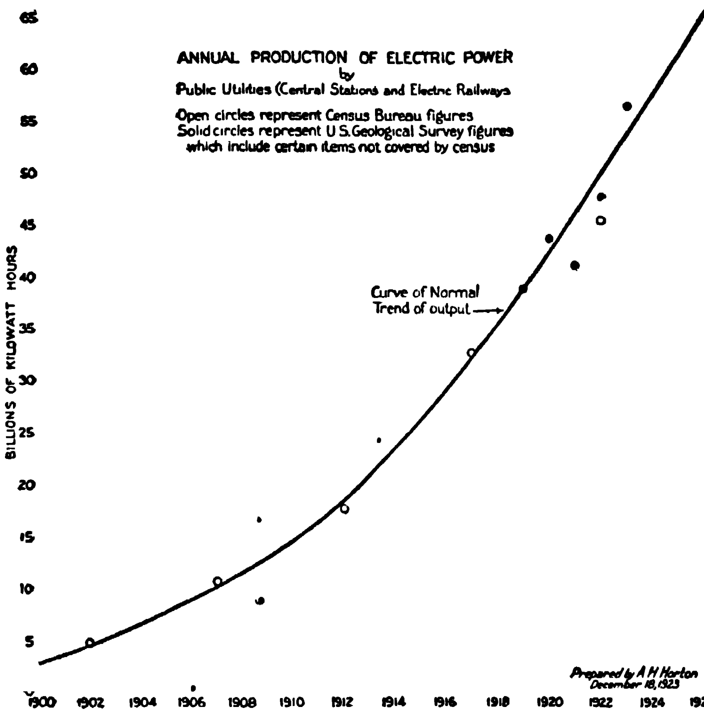


FIGURE 33. GROWTH OF ELECTRIC POWER BY CENTRAL STATIONS, 1902–23
(Data from Census and United States Geological Survey. Trend determined by A. H. Horton.)

the utilities take over an increasing share of the burden that had been carried by individual or private plants. This rapid increase in the business of the electric utilities has been caused in part by the distressing experience of industrial plants in securing fuel during the coal famines

brought about by strikes and traffic blockades. Industry has learned that it is much easier and also cheaper in practically all cases to obtain power by pulling a switch

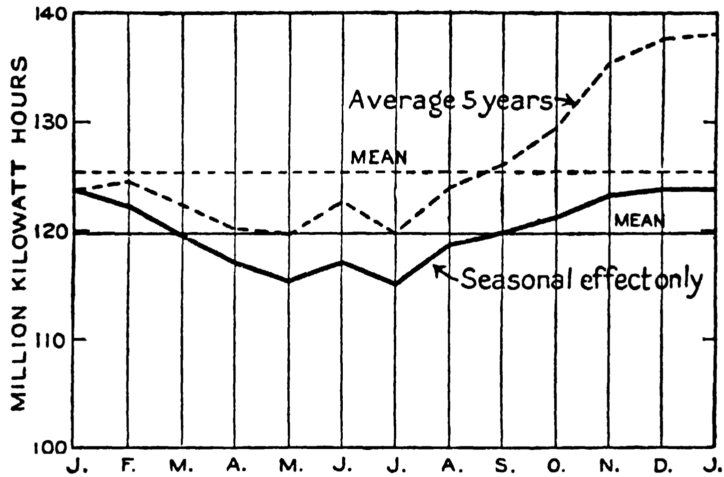


FIGURE 34. PROBABLE NORMAL SEASONAL VARIATION IN ELECTRIC POWER OUTPUT

(After A. H. Horton, United States Geological Survey.)

than it is to operate a steam power plant. The records for New York and New England show that the capacity of prime movers in manufacturing plants has reached a

Note: In Figure 35, the line at the top represents the numbers employed in industrial establishments. The data include women and minors and are based on reports of the United States Bureau of Labor Statistics and of the New York Industrial Commission. Correction is made for seasonal variation. The data are expressed as a per cent of the average for 1919. (From the *Review of Economic Statistics.*)

The middle line represents physical volume of manufactures. It is an adjusted index of the quantity of all manufactured goods produced, corrected for year-to-year growth and seasonal variation. (From the *Review of Economic Statistics.*)

The bottom chart compares the Harvard Index of Trade (dotted line) with an index of electrical power (solid line). The solid line is made up from monthly statistics of electric power production at public utility plants, published by the United States Geological Survey, and corrected for year-to-year growth and seasonal variation by the Federal Reserve Bank of New York.

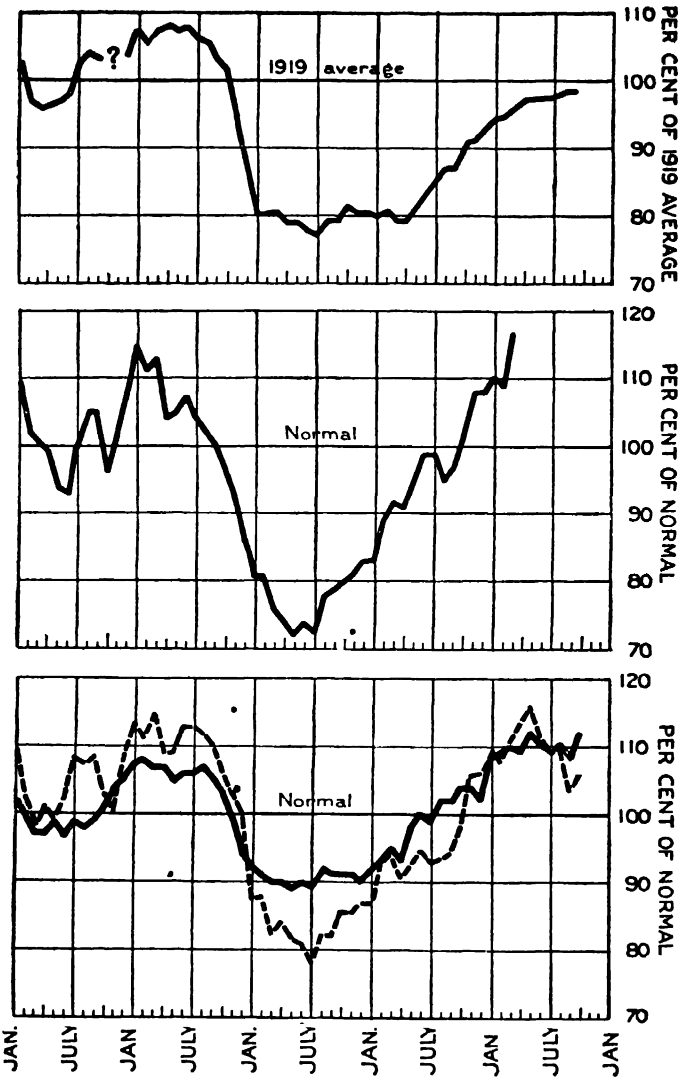


FIGURE 35. INDEX OF ELECTRIC POWER OUTPUT COMPARED WITH INDEXES OF EMPLOYMENT, MANUFACTURES AND VOLUME OF TRADE

(See footnote on opposite page.)

maximum and that power for manufacturing plants will more and more be furnished by electric public utilities.

For some years the rate of growth was like the compound-interest curve, and the increase amounted to ten per cent or even eleven per cent a year. It is doubtful, however, whether this increase can be maintained, and the engineers of the Geological Survey would represent the trend of power output by the curve of Figure 33.

Correction for seasonal variation is also needed, and the normal seasonal curve is indicated on Figure 34.

The curve for power output has not been under observation long enough to permit us to make these corrections for normal growth and seasonal variation with absolute assurance. Nevertheless, the adjusted figure is of the greatest significance. It promises to become a measure of one of the major factors in production, a measure available from month to month. It should in time take its place with the index of employment, the index of gross ton-miles of freight, and the index of the physical production of goods, as among the best measures of the economic life of the country.

In Figure 35 the best available indexes of these several factors in production are plotted on the same scale, the average for 1919 being taken as 100. The heavy black line in the bottom section of the diagram shows the course of power output. It follows very closely the index of trade indicated by the broken line, the index of volume of production of manufactured goods in the middle section, and the index of industrial employment at the top.

CHAPTER XIII

AVAILABLE METAL STATISTICS

By F. E. WORMSER and E. H. ROBIE

THE non-ferrous metal-mining industries are served by two kinds of statistics — non-secret and secret — by which we mean statistics given freely to mining companies and public alike, and those that circulate only among the producers who contribute to the gathering of the data. This classification does not include the statistical information supplied by the Government.

The zinc producers of the United States have an association which, without fear or favor, promptly gives publicity to figures showing accurately and intimately the momentary statistical position of the zinc-smelting industry. A monthly statement of production, shipments, stocks, and shipments abroad is given, and also the number of retorts in operation at the smelters, which is an index of the activity at those plants. On the other hand, the copper, lead, and silver producers, collectively, believe in secret statistics. Although they are provided with information similar to that supplied by the zinc association to its members and the public, this information is given a restricted distribution, principally among the officers of the companies supporting the service. Evidently there are two conflicting policies in the non-ferrous metal-mining industries regarding the release of statistical records: one favors the utmost secrecy and the other frank and free publicity. It is interesting to observe that some large mining and smelting companies that produce several important non-ferrous metals ac-

cept this veil of secrecy for, say, copper and lead, and, in the case of slab zinc, are satisfied with the present policy of full publicity. We believe that certain constructive steps might be taken not only to bring about a more uniform attitude on the part of the producers, but also to provide them with even more valuable statistical information than they now possess.

Let us first examine the condition in the zinc industry. Not so very many years ago, this great American industry was accused of being one of the most backward and unprogressive of metal industries, especially from a production standpoint. Technical coöperation was practiced by but few zinc companies. It was only during the War, when the need for organizing and operating the zinc mines and smelters of the country most efficiently was recognized, that producers began to mend their ways. An association of producers was formed which, a few years later, developed into the American Zinc Institute. It is this organization which gathers the statistics of the industry. Miners, smelters, manufacturers, and dealers comprise its membership, which has now become so comprehensive that fully 95 per cent of the zinc production of the United States is represented in it. The American Zinc Institute is essentially a trade association, and the statistics compiled by it come in the category of trade association compilations. Inasmuch as the trade association has been criticized and often condemned for its secret handling of statistical information, the directors of the American Zinc Institute decided that all data digested from the reports of the producers would be given prompt and widespread publicity. At the same time the decision was made to let matters of price severely alone, so that no possibility of violating any Federal law should arise. The system has worked splendidly in practice and has

furnished the zinc producers with a service which they would sorely miss, should it be suspended. The copper, lead, and silver producers have no association corresponding to the American Zinc Institute. They obtain their information from a central organization, formed purely for statistical purposes. They submit to it monthly statements of production, deliveries or shipments, and stocks. These figures are integrated, and a summary is distributed to each contributor, with the understanding that such data are confidential.

Measured in dollars and cents, or in the avoidance of violent fluctuations in the copper market, probably nothing is gained by secrecy. How could it be otherwise? Statistics in the metal industries can be interpreted so differently that if they are used as an infallible guide to the future of any commodity they are likely to be seriously misleading. Non-ferrous metal statistics are not on a parallel with those gathered in wheat, cotton, and sugar, in which estimates of prospective yield are exceedingly valuable in any analysis of market conditions.[1] The production of these commodities depends upon the acreage planted, the vicissitudes of the weather, and the ravages of insect pests. Not so with the metals. Their production is easily varied and depends upon the policies of individual producers. At best the statistics of the non-ferrous metal-mining industries must be construed broadly, or they are given a false importance. It is interesting to note that, although the copper-mining industry is supplied with exhaustive monthly statistics of production, deliveries into consumption, and stocks, the copper market is noted for its violent fluctuations. The two have probably no direct connection; but, armed with valuable statistical data, copper producers have not been able to

[1] See Chapters XV to XVIII, below.

avoid these harmful rises and declines in prices. Recently, electrolytic copper advanced seven per cent in one week. The following week it declined just about as rapidly as it had advanced.

So far nothing has been said about tin statistics. This metal is not produced from domestic ores; in fact, it is now smelted to only a small extent in this country from foreign ores. Nevertheless, as half the world's production of tin is consumed in this country, knowledge of the stocks and current and probable future supplies is of importance to many of our industrial concerns. As most of the tin that is produced is under British control, and is marketed through two large dealers in London, the matter of statistics is largely beyond the control of any one in the United States. However, it is a fact — and this statement is of particular interest in view of the success of Britain as a commercial nation — that British companies collect and publish commercial statistics much more freely than do American companies. Mining is no exception, and we have therefore acceptable data on foreign tin production and stocks. There is, however, what is known as the invisible supply, which partly represents the stock of tin in the hands of consumers; without this figure it is difficult to get an accurate picture of the industry.

In this country, the New York Metal Exchange collects and publishes the tin statistics from day to day. This exchange also supplies a report on the price of nonferrous metals to a large number of newspapers throughout the country. However, the New York Metal Exchange is really an exchange in name only, for rarely is any trading done on its floor, with the exception of small dealings in tin. It is merely a meeting place for some of the New York metal dealers, largely for the exchange of

market gossip. The prices of copper, lead, zinc, and some other metals there established are only nominal, and should be so regarded by those who scan them in the press of the country. There are no authoritative, complete, daily reports of metal prices and sales on exchanges, as there are of grain, cotton, sugar, and many other commodities, where trading is done on an organized market. Instead, the industry must depend upon estimates of the business done, as reported by trade papers and magazines, which estimates vary in accuracy with their source.

Do the recipients of the statistical information act upon their interpretation of it? We have reason to doubt it, from more examples than one. The copper industry is an illustration. At present it is burdened with an overproduction. Monthly statistics have shown this repeatedly. Consequently, the price of copper is abnormally, even ridiculously, low. Yet do any of the producers show any inclination to curtail production? On the contrary, some of them have actually increased it. This is only another illustration of the unreliability of statistical information as an indication of probable future action. The high-cost copper producers are running at the highest possible pitch to produce the metal as cheaply as possible. For a similar reason, the low-cost mining companies are pursuing the same course. They are especially dependent upon large-scale production to produce copper at the lowest cost. Those copper producers who feel that the withholding of statistics from the public is desirable can hardly point to the behavior of their market — which is the acid test to apply — as vindication of their belief.

The zinc producers are generally agreed that the publication of their summarized monthly records has not had any detrimental effect on their business. During the

year 1923, prices did not move sharply, so far as we have been able to judge, in sympathy with the showing made by any published figures. This was to be expected, as markets have a way of discounting favorable and unfavorable factors, long before they are expressed in statistics. The zinc market in 1923 moved slowly, upward, and downward — a decided contrast to the erratic course of the copper market. Oddly enough, the position of the zinc producers is even more vulnerable than that of the copper-mining companies. The slab zinc statistics are gathered from the smelters, who, unlike the copper smelters, are dependent for their ore supplies largely upon purchases in the Joplin ore market. Mining and smelting are two distinct groups of enterprises in the zinc industry. Miners and smelters negotiate each week over the price of ore. Thus, the figures compiled by the American Zinc Institute are subject to the scrutiny not only of consumers — such as galvanizers or brass manufacturers — but also to the examination of ore sellers supplying the smelters. The zinc smelter has, therefore, even greater reason than the copper smelter for withholding his figures from the public. That he does not and that no ill effects are observable from publication of the statistics is strong evidence that the prompt release of vital industrial statistical information does not work injury to the issuing agencies and their constituents. The enlightened policy of the zinc industry in regard to its statistics is most progressive and has led, probably, to a betterment of its position in commerce.

What can be done to improve the scope or quality of the information now gathered by the non-ferrous metal producers? An important forward stride would be to remove the objection some producers now have against releasing their own statistical compilations — that is, to

obtain data regarding the state of the consuming industries. We have good reason to believe that, if the manufacturer of metal products indicated a willingness to gather and supply such information, the producers would be glad to exchange information and to make the whole story public. The data desired from consumers, lumped together, would be the stocks of metal on hand, in process, and shipments arriving during the month, together with monthly orders and unfilled orders. Combined with the producers' figures, what a splendid picture of each industry that would be: first, the production of the raw material, stocks of it on hand at the smelters or refineries, deliveries during the month; then the amount of the consumers' stocks, and sufficient data to gage manufacturing activity.

So far, consumers do not seem to have combined for the purpose of the interchange of information regarding their raw material to the same extent as producers. The galvanizing interests are probably the best organized in this regard. It is said on good authority that every sale of zinc to a galvanizing interest is on the table of every other important galvanizer the next morning, with full particulars as to price, tonnage, delivery, seller, and buyer. The interests of producers and consumers are not wide apart. Producers want a fair price for their product, to which no consumer would find objection. At the same time they are both interested in having the market fluctuate slowly. A statistical picture of the whole industry, from the production of the raw material to the manufacture and disposal of the finished product, would be of great advantage and would help producer and consumer in smoothing those peaks and depressions in the price curve that are so disastrous to industry. There would seem to be a fair prospect of bringing about this desirable

result if both producers and consumers were approached by a disinterested third party who could be depended upon to prevent leaks of individual reports. The great value of the statistical summary, covering both producers and consumers, we believe would be admitted by all.

CHAPTER XIV

FORECASTING PETROLEUM PRODUCTION

By JOSEPH E. POGUE

Change in the momentum of crude oil production

If the production of crude petroleum in the United States by years from 1907 to 1923 be plotted on semi-logarithmic paper, so that the rate of change is readily visualized, it may be observed that the rate of increase shifted, in 1919, from a remarkably even increase of 7.1 per cent to a steeper and less even gradient representing an average annual increase of 16.6 per cent. (See Figure 36.) These facts may be demonstrated mathematically by fitting a compound interest curve to the two sets of data, as shown in Tables 24 and 25.

That the production of crude petroleum should increase geometrically, rather than arithmetically, is not surprising in view of the competitive conditions under which this product is produced whereby development goes forward in ever-widening circles.[1] But that the rate of increase should display a definite alteration in 1919 to a higher rate, which has thereafter been maintained, calls for explanation; a new factor must have come into action. To account for this change we offer the theory developed below.

Explanation of the increased momentum

During the War period the supply of crude petroleum was out-distanced by increasing requirements, and stocks of crude petroleum were drawn upon almost con-

[1] See Joseph E. Pogue, *The Economics of Petroleum* (1921), pp. 31–34.

TABLE 24. RATE OF INCREASE IN CRUDE OIL PRODUCTION IN THE UNITED STATES, 1907–19[a]

(Unit: one million barrels)

Year	Actual Production	Calculated Production[b]
1907	166	165
1908	179	176
1909	183	189
1910	210	202
1911	220	217
1912	223	233
1913	248	249
1914	266	267
1915	281	286
1916	301	306
1917	335	328
1918	356	351
1919	378	376

[a] Determined by fitting a compound-interest curve ($y=248.8\ (1.071)^x$, origin at 1913) to the data by the method of least squares. Data from United States Geological Survey.

[b] Standard deviation of calculated production from actual values equals 5.17 million barrels.

tinuously from late 1915 to the end of 1918.[1] As a result, the idea gained ground that the petroleum resource of the United States was quite limited in size; estimates of the unmined reserve were made by geologists and widely published to the effect that the ultimate production of the country would be of the order of magnitude of nine billion barrels; and in general the conviction grew that the United States was facing an early shortage of oil and would soon become dependent upon foreign sources of supply. The shortage-idea reached an active and aggressive stage by 1919, a year which culminated in a spectac-

[1] In this study, imports and exports of crude petroleum were left out of consideration in order to simplify the presentation of results. Their inclusion would have complicated the argument, but would not have changed the principles involved or conclusions reached.

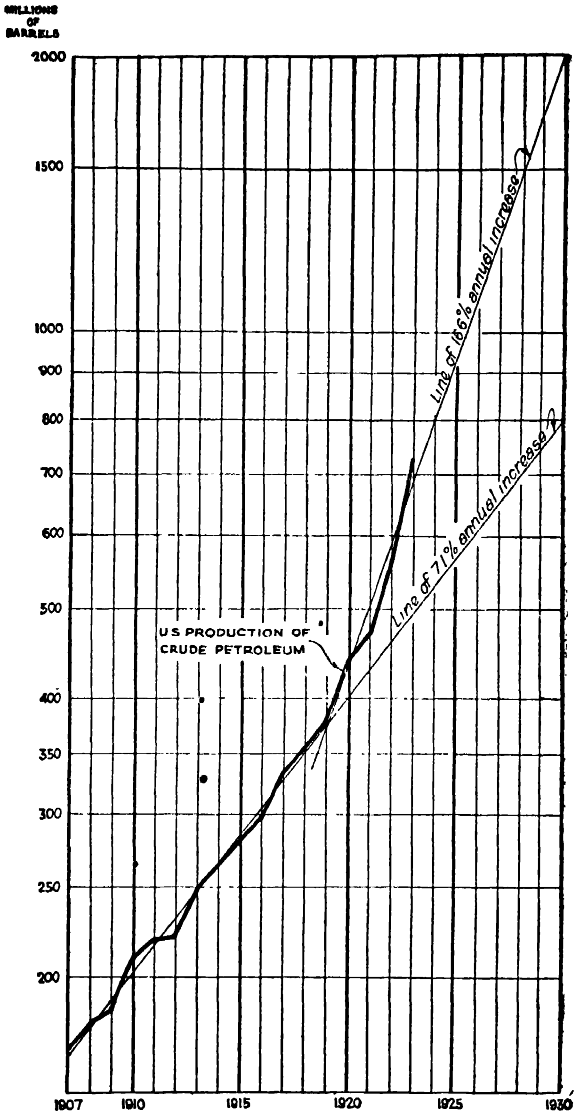


FIGURE 36. TREND OF THE PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES BY YEARS, 1907–23

TABLE 25. RATE OF INCREASE IN CRUDE OIL PRODUCTION IN THE UNITED STATES, 1919–23[a]

(Unit: one million barrels)

Year	Actual Production	Calculated Production[c]
1919	378	369
1920	443	431
1921	472	502
1922	558	586
1923	726[b]	683

[a] Determined by fitting a compound-interest curve ($y = 502.1\ (1.166)^x$, origin at 1921) to the data by the method of least squares. Data from United States Geological Survey.

[b] Last three months estimated.

[c] Standard deviation of calculated production from actual values equals 27.4 million barrels.

ular rise in the value of oil securities and was followed in turn, during 1920, by a notable advance in the prices of crude petroleum and its derivatives.

The years 1919 and 1920 were marked by an exceptional flow of new capital into the petroleum industry. Adequate statistics are lacking to measure the absolute amount of new capital so attracted, but an index of the relative importance of this factor is afforded by the figures representing the new incorporations of oil and gas companies as reported by the New York *Journal of Commerce.* These data are shown in graphic form in Figure 37, where the significance of 1919 and 1920 in the respect specified is clearly apparent.

Between 1919 and the present, there has been a notable advance in the technique of oil-finding and oil-production. This advance has been in the direction of speeding the finding and exploitation of new oil-pools; and, as it is now well known to petroleum engineers that rapid drilling is conducive to a more complete extraction of oil,[1]

[1] For a good summary of the evidence on this point, see G. C. Gester, S. H. Gester, and E. W. Wagy, "Oil and Gas Conservation," *Standard Oil Bulletin* (San Francisco, December, 1923), pp. 2–4.

this acceleration of exploitation has not only had the primary effect of increasing production directly but the secondary effect of enlarging the percentage of recovery

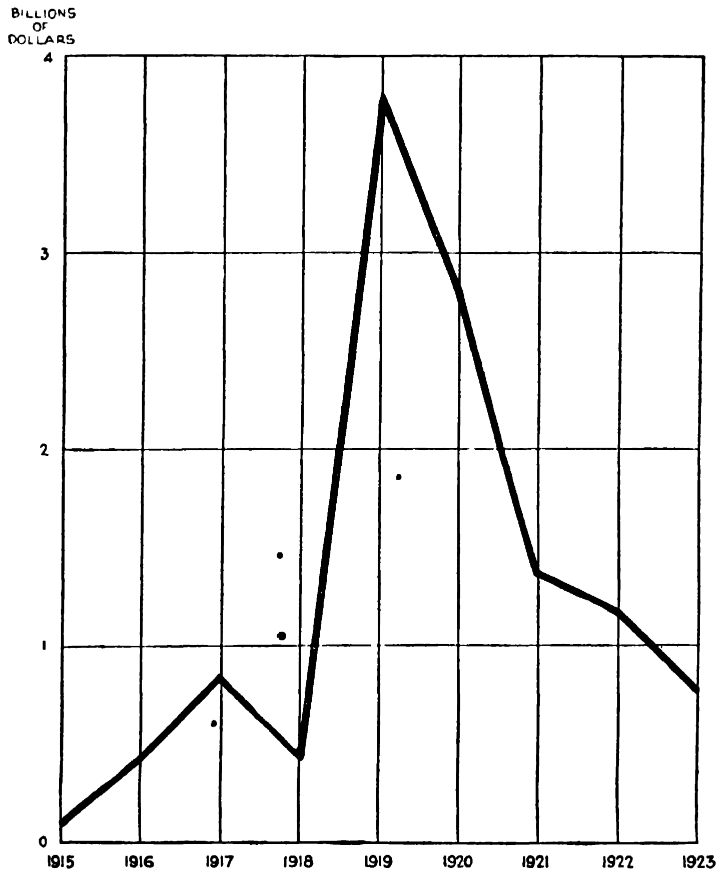


FIGURE 37. NEW INCORPORATIONS OF OIL AND GAS COMPANIES IN THE UNITED STATES BY YEARS, 1915–23

as well. That production has been facilitated during the past few years by better methods is demonstrated by the well data presented in Table 26, which shows that produc-

tion has been increased not primarily by drilling more wells (the *rate* of drilling since 1919 is not materially higher than for the period 1913–18) but through the agency of wells of larger average yield. The rate of crude oil production has been doubled with no substantial increase in the volume of drilling. Better, faster, and deeper drilling are responsible.

TABLE 26. WELL DATA COVERING THE OIL FIELDS OF THE UNITED STATES (EXCLUSIVE OF CALIFORNIA) BY YEARS, 1913–23[1]

YEAR	NUMBER OF OIL WELLS COMPLETED	TOTAL INITIAL DAILY PRODUCTION (thousands of barrels)	AVERAGE INITIAL DAILY PRODUCTION PER WELL (barrels)
1913	18,824	781	42
1914	16,140	1471	91
1915	8,892	1715	193
1916	18,080	1497	83
1917	15,673	1383	88
1918	16,698	1486	88
1919	20,686	3366	163
1920	23,738	3339	141
1921	13,943	2640	189
1922	16,201	3912	241
1923[a]	14,548	4440	305

[a] Eleven months.

To the oil producer or petroleum engineer, the items of progress in oil-field technique are well known. Lack of space permits only a bare enumeration of them here. These items include: the advancement and wider application of the science of geology; the improvement and broader use of the methods of rotary drilling, including the development of coring technique in advance of the drill; the wider employment of diamond drilling in exploration; the improvement of oil-well machinery, per-

[1] Data from *The Oil and Gas Journal.*

mitting faster and deeper drilling; the employment of bonuses, better organization, and other superior managerial methods in gaining greater speed and efficiency from the human factor; and more rapid transportation of oil-field supplies through the use of the motor truck.

TABLE 27. LIST OF ALL OIL-POOLS IN THE UNITED STATES WHICH HAVE REACHED A DAILY RATE OF OUTPUT EXCEEDING 100,000 BARRELS[a]

POOL	DATE OF DISCOVERY	DATE OF MAXIMUM PRODUCTION	MAXIMUM PRODUCTION (bbls. per day)	PRODUCTION JAN. 5, 1924 (bbls. per day)
Above 300,000 barrels per day				
Cushing, Oklahoma ..	Mar. 1912	Apr. 1915	310,000	24,000
Santa Fé Springs, Cal...	Oct. 1921	Aug. 1923	340,000	159,000
Powell, Texas..........	Jan. 1923	Nov. 1923	325,000	77,000
Above 200,000 barrels per day				
Long Beach, Cal.......	June 1921	Oct. 1923	255,000	228,000
Above 100,000 barrels per day				
Spindletop, Texas. .	Jan. 1901	July 1901	100,000[b]	550
Humble, Texas. . .	Dec. 1904	June 1905	130,000	4,850
Midway-Sunset, Cal.[c].	1900	June 1914	150,000	75,000
Burkburnett, Texas . ..	(?)1917	Aug. 1919	109,000	23,000
Breckenridge, Texas	1916	Jan. 1921	124,000	22,000
Mexia, Texas...... .. .	Mar. 1921	Jan. 1922	147,000	42,000
Haynesville, La.	Mar. 1921	Mar. 1922	100,000[d]	22,000
Huntington Beach, Cal.	Oct. 1919	Apr. 1923	126,000	66,000
Tonkawa, Okla.	June 1921	May 1923	115,000	42,000
Salt Creek, Wyo..	Apr. 1912	June 1923	173,000[e]	108,000
Burbank, Okla.	May 1920	June 1923	122,000	70,000
Smackover, Ark[f] . .	July 1922	June 1923	125,000	96,000

[a] Eight out of the sixteen pools reached their peaks during the last nine months of 1923. The combined 1923 maxima of those eight pools equalled 1,538,000 barrels per day, sixty-nine per cent of the maximum daily rate of crude oil production in the United States.

[b] Records of the maximum output of the Spindletop pool are lacking, but the pool very probably exceeded 100,000 barrels per day.

[c] These figures are for the Midway and Sunset pools combined, but the Midway pool alone exceeded 100,000 barrels per day.

[d] The American Petroleum Institute reported Haynesville as averaging 95,850 barrels per day for the week ending March 25, 1922, during that week the pool doubtless reached 100,000 barrels for a brief period.

[e] Potential production according to June field test.

[f] Possibly one or two other pools may have reached 100,000 barrels on a single peak day, but the available records do not definitely indicate that such was the case. The Glenn pool in Oklahoma may have reached 100,000 barrels in October, 1907, when the United States Geological Survey reported the average production for that month to be 79,000 barrels per day.

That these conditions have had a notable effect upon oil production may be demonstrated further by the bunching of major oil-pools in the past five years, and

particularly in 1923. During the development of the American petroleum industry over the past sixty years, there have been only sixteen oil-pools which have attained a maximum rate of output exceeding one hundred thousand barrels per day. (See Table 27.) And of these sixteen major pools, two reached their maxima in 1914–15, one in 1921, and eight in 1923! Of the eight pools peaking in 1923, one was discovered early in 1923, one was discovered in 1922, four were discovered in 1921, one was discovered in 1920, one in 1919, and one in 1912. In other words, seven of the sixteen major oil-pools were found in the past five years. This bunching of large pools supported the increased momentum of production shown in Figure 36.

The theory is therefore offered that the shortage-idea, attracting new capital to the industry in large amounts through its speculative implications, stimulated new technique and the broader application of old technique to the degree that the rate of crude-oil production was increased from 7.1 per cent per annum to 16.6 per cent per annum. The importance of this new factor may be expressed by the equation $a = 1.088$, derived by taking the difference between the equation of the two straight lines in Figure 36, as expressed in the logarithmic form, and converting this difference into its antilog. This derived equation means that crude-oil production, over the period 1919–23, has been accelerated 8.8 per cent per annum over its normal rate by the sequence: shortage idea ⟶ new capital ⟶ improved technique.

Effects of the increased momentum

The result of increasing the rate of domestic crude-oil production from 7.1 per cent per annum to 16.6 per cent per annum has been an almost unbroken period of over-

production, lasting from the middle of 1920 to the end of 1923. Oil has been found faster than it could be consumed. The rate of growth of the consumption of crude oil is controlled by the rate of growth of the market for gasoline. The domestic consumption of gasoline from 1917 to 1923 (the period over which annual statistics are available) has increased at the average annual rate of 15.9 per cent. (See Figure 38 and Table 28.) This rate is only slightly less than the 16.6 per cent annual increase which has characterized the produc-

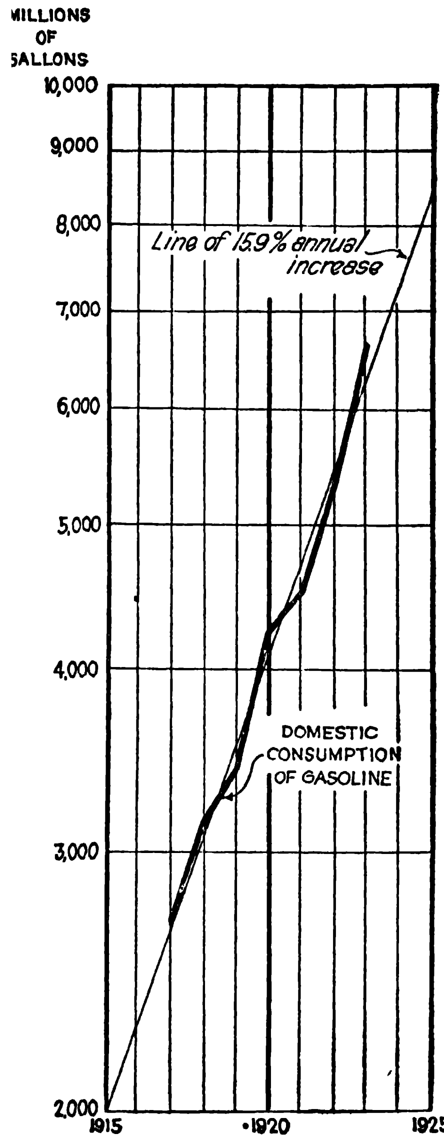


FIGURE 38. TREND OF THE CONSUMPTION OF GASOLINE IN THE UNITED STATES BY YEARS, 1917–23

tion of crude petroleum since 1919; and the difference would not have given rise to serious overproduction had there not been another factor, the increasing extraction of gasoline from crude petroleum as the result of progress in chemical engineering.

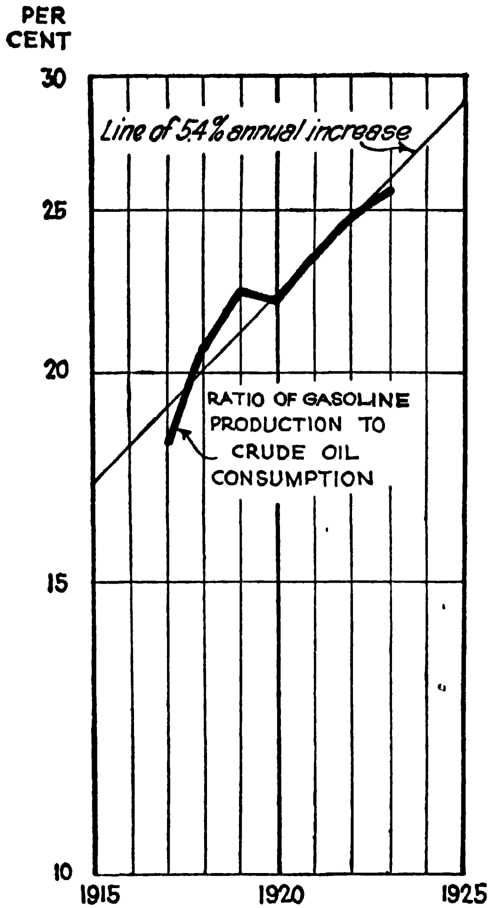


FIGURE 39. TREND OF THE RATIO OF GASOLINE PRODUCTION TO CRUDE OIL CONSUMPTION IN THE UNITED STATES BY YEARS, 1917–23

This factor, likewise the result of improved technique, may be measured by computing the ratio between gasoline production and crude-oil consumption and determining the trend of this ratio. The results of this procedure are shown in Figure 39 and Table 29. It may there be seen that improved technology in refining has, over the period 1919–23, accelerated the extraction of gasoline to the extent of 5.4 per cent per year. Therefore, the eco-

TABLE 28. RATE OF INCREASE IN GASOLINE CONSUMPTION IN THE UNITED STATES, 1917–23[1]

(*Unit: million gallons*)

YEAR	ACTUAL CONSUMPTION	CALCULATED CONSUMPTION
1917	2695	2641
1918	3123	3061
1919	3438	3547
1920	4256	4111
1921	4516	4765
1922	5382	5523
1923	6700[a]	6402

[a] Last three months of 1923 are estimated.

TABLE 29. RATE OF INCREASE IN THE RATIO OF GASOLINE PRODUCTION TO CRUDE-OIL CONSUMPTION IN THE UNITED STATES BY YEARS, 1917–23[2]

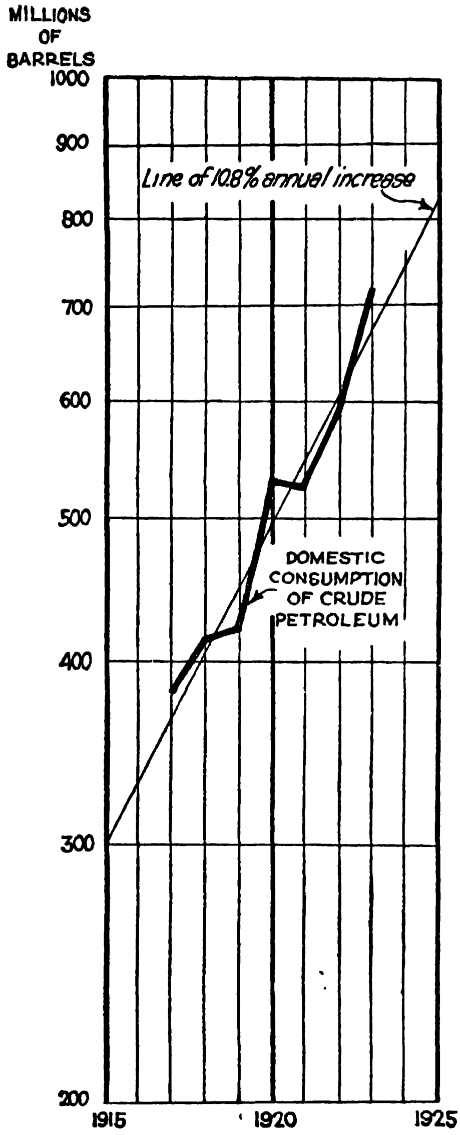
YEAR	GASOLINE PRODUCTION (million barrels)	CRUDE-OIL CONSUMPTION (million barrels)	ACTUAL RATIO (Per cent)	CALCULATED RATIO (Per cent)
1917	67.9	378.3	17.9	19.0
1918	85.0	412.3	20.6	20.0
1919	94.2	420.5	22.4	21.1
1920	116.4	530.5	22.0	22.2
1921	122.8	526.0	23.4	23.4
1922	145.2	592.4	24.6	24.7
1923[a]	133.9	523.6	25.6	26.0

[a] Nine months.

nomic force of chemical technology in gasoline production may be expressed by the formula: $a = 1.054$. As a result of the interposition of the factor of improved technique

[1] Determined by fitting a compound interest curve ($y = 4111\ (1.159)^x$, origin at 1920) to the data by the method of least squares. Data from United States Bureau of Mines.

[2] Determined by fitting a compound interest curve ($y = 22.2\ (1.054)^x$, origin at 1920) to the data by the method of least squares. Data from United States Geological Survey and United States Bureau of Mines.



in refining, the rate of increase in crude-oil requirements has been reduced from 15.9 per cent per annum, which would have been the rate if the recovery of gasoline had remained static, to 10.8 per cent per annum, the average rate of increase of actual crude-oil consumption over the period 1917–23. (See Figure 40 and Table 30.)

By subtracting the rate of crude-oil consumption from the rate of crude-oil production, we find that the excess of acceleration in respect to requirements may be represented by the factor, $a = 1.052$; that is to say, crude-oil production was actually

FIGURE 40. TREND OF THE CONSUMPTION OF CRUDE PETROLEUM IN THE UNITED STATES BY YEARS, 1917–23

TABLE 30. RATE OF INCREASE IN THE CONSUMPTION OF CRUDE PETROLEUM IN THE UNITED STATES BY YEARS, 1917–23[1]

(*Unit: one million barrels*)

YEAR	ACTUAL CONSUMPTION	CALCULATED CONSUMPTION
1917	378	367
1918	412	407
1919	421	451
1920	531	500
1921	525	554
1922	592	614
1923	719[a]	680

[a] Last two months estimated.

accelerated to the degree of 8.8 per cent per annum in excess of normal, whereas only an acceleration of 3.4 per cent per annum above normal was necessary to balance supply and demand. Thus, improved technique created an acceleration of 3.4 per cent which performed a useful purpose and in addition an acceleration of 5.2 per cent which resulted in overproduction and economic waste. In other words, sixty per cent of the force of improved technology went toward the creation of overproduction and hence performed no useful economic purpose. This waste of effort was paid for by the petroleum industry in the form of depression, low prices, and inventory losses.

Bearing upon the future

In appraising the future effect of the present momentum in crude-oil production, we have to consider the counter economic forces set up by a condition of overproduction and the possible entrance of a new factor, the resource limitation. Overproduction, creating low prices,

[1] Determined by fitting a compound interest curve ($y = 500\ (1.108)^x$, origin at 1920) to the data by the method of least squares. Data from United States Geological Survey.

tends to accelerate demand and retard supply. Consumption of oil has been increased as a result of the oversupply, while at the same time drilling and exploration have slowed down, part of the capital in the industry destroyed, and the vitality of the shortage-idea lessened. These conditions alone are making for equilibrium between supply and demand, at least for a period; but the power of improved technology is left unimpaired, even though the motive force behind it is weakened. Thus, with revival of the motive force, other things being equal, the factor of technique stands ready to repeat its recent performance.

A new factor, however, must be taken into consideration. Petroleum is a wasting asset; individual oil-fields become quickly depleted; and new pools must be brought in, in ever-increasing numbers, if given rates of increase in production are to be maintained. The limiting factor of resource size comes into the equation. Several estimates of the size of the unmined reserve of petroleum have been made by authoritativo bodies of geologists. These estimates agree in placing the ultimate supply of recoverable oil at a figure of the order of magnitude of nine billion barrels. While these estimates have probably substantially underestimated the unknown possibilities of the country, they nevertheless emphasize the presence of a resource limitation which sooner or later must affect the rate of production. Just as the production of each pool increases, reaches a maximum, and subsequently declines, tracing a course resembling a frequency distribution skewed to the right; so the output of the entire country, being merely a composite of individual pools, may be expected to follow a similar course, but with the skewing perhaps accentuated by further development of technology.

Reverting to Figure 36, one may ask whether the production curve will follow its recent course into 1924 and thereafter. As to 1924, it may be answered with considerable confidence that the momentum of oil production has received sufficient check to assure an output for 1924 that will represent no increase over 1923 and probably an actual decrease. As to 1925 and later, the answer is not so definite; but unless the factor of resource limitation becomes effective, a sufficient advance in price would doubtless renew a 16.6 per cent impetus. But from a study of the petroleum resource and from discussions of the matter with many geologists, petroleum engineers, and oil-producers, the writer ventures the opinion that the factor of resource limitation will begin to retard the momentum of oil-production in the United States in the near future, and that 1924 will bring a change in the trend of crude-oil production such that the production curve, as shown in Figure 36, will assume a gradient less steep than has characterized the past five years — a gradient that may ultimately, possibly in five to ten years, cause the curve of total production to intersect the projected trend of the period 1907–19.

Summary

The conclusions reached in this study may be briefly summarized as follows:

1. The rate of increase in crude-oil production in the United States, which averaged 7.1 per cent per annum over the period 1907–19, underwent an acceleration to an average rate of 16.6 per cent per annum over the period 1919–23.

2. This sharp increase in momentum was the result of improved technique in oil-finding and oil-production, under the stimulus of an extraordinary flow of new cap-

ital into the petroleum industry, attracted by the idea that an oil-shortage lay ahead.

3. The simultaneous development of improved technique in refining, leading to the larger extraction of gasoline from crude oil, also stimulated by capital inflow induced by the shortage idea, retarded the rate of increase of the demand for crude oil to the extent that roughly two thirds of the impetus of crude-oil production derived from improved technology was in excess of economic requirements and led to overproduction.

4. The low prices resulting from overproduction have created a sufficient check on the momentum of oil production to promise a probable decline in crude-oil output in 1924 as compared with 1923.

5. In the near future, the factor of resource limitation may be expected to create a further check on the momentum of crude-oil production, and the tentative conclusion is offered that 1924 will bring the beginning of a change in the trend of crude-oil production to a gentler gradient.

CHAPTER XV

FLUCTUATIONS IN COAL PRODUCTION[1]

By DAVID L. WING and F. G. TRYON

Our purpose is to trace the reaction of one of the principal mining industries to the alternating periods of prosperity and depression that make up the business cycle, with the thought that foresight is sharpened by hindsight and that any attempt to minimize the ill effects of a depression must begin with a thorough understanding of what happens during the depression. The bituminous-coal-mining industry may well be selected for such a study, because the records of its growth are now more extensive than those of the other mineral industries and because many of its problems are typical of mining in general.

Underlying facts

In considering the reaction of the business of mining and marketing bituminous coal to the business cycle, certain underlying facts should be borne in mind:

Consumption of bituminous coal. Although the quantity of soft coal used for household fuel is just about equal to the quantity of anthracite so used, it is overshadowed by the much larger amount required to supply the industrial demand. Fully seventy-three per cent of the bitu-

[1] This paper includes hitherto unpublished data collected by the United States Geological Survey and the United States Coal Commission, and is published with the permission of the Director of the Survey. It deals exclusively with bituminous coal and does not refer to anthracite, for which conditions are different.

The complete paper with detailed tables, from which this abstract was taken, may be had upon application to the Geological Survey.

minous coal mined goes to railroads and industries whose demands fluctuate directly with the business cycle. About twenty per cent of the output is consumed by the iron and steel industry, either in the form of coke or as gas or steam coal; and for this reason bituminous coal is quick to feel any change in the iron market.

Excess capacity. The well-known fact that the industry has been developed to a capacity in excess of that necessary to supply the demand has an important bearing on its reaction to the business cycle. General business activity does not necessarily increase the price of coal, for the mines can produce far more coal than business can consume. Not until some other cause, such as congestion of the railroads or a miners' strike, intervenes to prevent operation of the mines at full capacity does the price rise materially.

Periodic strikes. General strikes or "suspensions" in the organized fields have occurred at the termination of many of the biennial wage agreements, and some of them have thrown the industry out of step with the business cycle for several months. In fact, shortages that were traceable directly to big strikes have been a more potent cause of changes in the prosperity of the coal-mining industry than the movements of general business.

Division into union and non-union fields. Fully sixty-five per cent of the bituminous industry is unionized and operates under rigid wage scales fixed by contracts that normally run for two years. The other thirty-five per cent is non-union and pays such wage rates as the operators may deem expedient — rates which in prosperous times may be equal to, or perhaps even above, the union scale, but which, in times of depression, may be below that scale. This unequal competition between the operator who has a relatively fixed labor cost and the oper-

ator who has a flexible labor cost lays excessive burdens upon the union operator in times of depression; but it may make possible fairly steady operation for the non-union operator.

Effect of the War. The extraordinary prosperity of the bituminous operators from 1916 to 1918 was due primarily to the War, and only secondarily to the crest of the business cycle then in progress. Not only was coal required in greatly increased amounts for the manufacture of steel and munitions, but the delivery of coal was impeded by failures of transportation and distribution; and prices rose to levels before undreamed of.

Fluctuations in output

Annual production. Professor Day has determined the normal growth of the industry from 1899 to 1919 to be at the rate of 16,800,000 tons a year. At this rate, the normal output for 1918 would have been 530,000,000 tons. The fluctuations in actual output above and below the line of normal growth have ranged from eight per cent below, in 1908 and in 1914–15, to fifteen per cent above in 1907, and nine per cent above in 1918. Various signs show that this rate of growth has now commenced to slacken. Thus, the output in 1919 was but eighty-five per cent of Professor Day's normal. In 1920, it was one hundred and one per cent. In 1921, the depression carried it down to seventy-one per cent. It appears that a combination of (a) economies in utilization resulting from the high price of coal, (b) competition of fuel oil and water power, and (c) perhaps actual slowing up in the rate of increase of the country's requirements of coal have changed the slope of the line of normal growth.

The point to be noted, however, is that the departures from normal in the output of bituminous coal are less ex-

treme than those in some other businesses — for example, pig-iron.

Monthly production, 1905–23. Bituminous coal is to be classed primarily among producers' goods and, like other producers' goods, it responds fairly quickly to changes in the state of trade. To measure the interval in time between the beginning of a financial depression and the first signs of slackening in bituminous output, we have prepared estimates of the monthly output of soft coal back to January, 1905. These figures, here published for the first time (monthly data for years prior to 1913 not having heretofore been available) show that the decline in the output of coal begins about the same time as the decline in the general volume of trade.[1] To this statement exceptions must be made for years like 1910 and 1920, when some external cause, like a big strike or a railway congestion, happened to be effective at the time the business crisis appeared. Under such circumstances the bituminous-coal industry may continue to feel an artificial prosperity after other industries have begun to slacken their pace, simply because people have burned up their stocks and feel that they must replenish them. But in 1908, 1914, and also in the years when the pace of business was increasing, the curve of bituminous-coal production responds to the changing tone of business at about the same time as the curve of total volume of trade.

To sum up, the output of bituminous coal is not a forecaster of future business change; but it is one of the measures of the extent of a change already begun. Its value as a business indicator is marred by the ebb and flow of coal into storage in anticipation of strikes and by the great dislocation caused by the strikes themselves. Moreover, it is unduly affected by the production of iron

[1] See Figures 23–35, above, especially 30 and 31.

and steel, which consumes an amount of coal out of all proportion to the value of iron and steel products.

Changes in price

The curve of spot price (Figure 41) shows that labor disturbances within the trade itself have been more important in explaining sudden variations in price than have business cycles. Thus, the extraordinary peak reached in 1920, when the average spot price for the entire country rose to $9.50 f.o.b. mines, was due to the miners' strike of 1919 and the subsequent traffic jams; and the lesser peak reached in 1922 was due, not to changes in the general price-level, but to a strike.

These data represent the spot or open market price rather than the contract price-level, and it must be remembered that only about twenty-five per cent of the total output is sold on the spot market. Changes in the average sales realization on all coal shipped, whether spot or contract, more nearly accord with the movement of general business; but even the proportion of these changes that are directly attributable to business cycles is small. In 1907, the boom year, the average sales realization was $1.14 per ton. In the following depression year, it was $1.12. In 1909, it was $1.07. The small range of these fluctuations between good and bad times confirms the conclusion already stated: that some more active and powerful cause than the quickening pace of business is necessary to produce high prices of bituminous coal.

Reaction of the price of coal upon other business. The effect of violent fluctuations in the price of coal upon industries consuming coal cannot be stated in figures. seems clear, however, that great uncertainty as to the price of a basic commodity cannot but unsettle business, whether it operate to precipitate the depression, as in

1920, or to delay recovery, as in 1922. Even more serious than the uncertainty of price is the uncertainty of supply. The index curve of volume of trade shows three downward

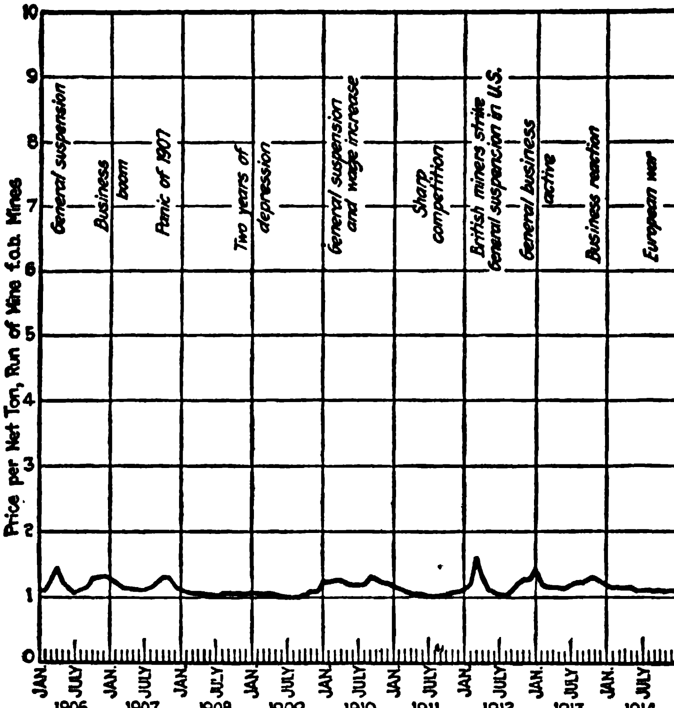


FIGURE 41 (SECTION 1). MONTHLY AVERAGE SPOT PRICE OF BITUMINOUS COAL, F.O.B. MINES, IN DOLLARS

(Data for 1913–23 are C F Lesher's average spot prices of fourteen coals, representative of nearly ninety per cent of the bituminous output of the United States, weighted, first, with respect to the proportions of slack, prepared, and run-of-mine normally shipped; and, second, with respect to the tonnage of each normally produced. This average is published currently in *Coal Age* Data for 1912 and earlier years have been compiled in as nearly the same way as the records permit, and, though subject to revision, are fairly comparable. Figures 41–43 inclusive are from the United States Geological Survey.)

jogs that are directly associated with failure in deliveries of coal: one in January, 1918, with its heatless days and lightless nights; the others conjoined with the strikes of 1919 and 1922.

Effect of increased price on output. After the price has reached a level high enough to call into active production the substantial commercial operators, further increase

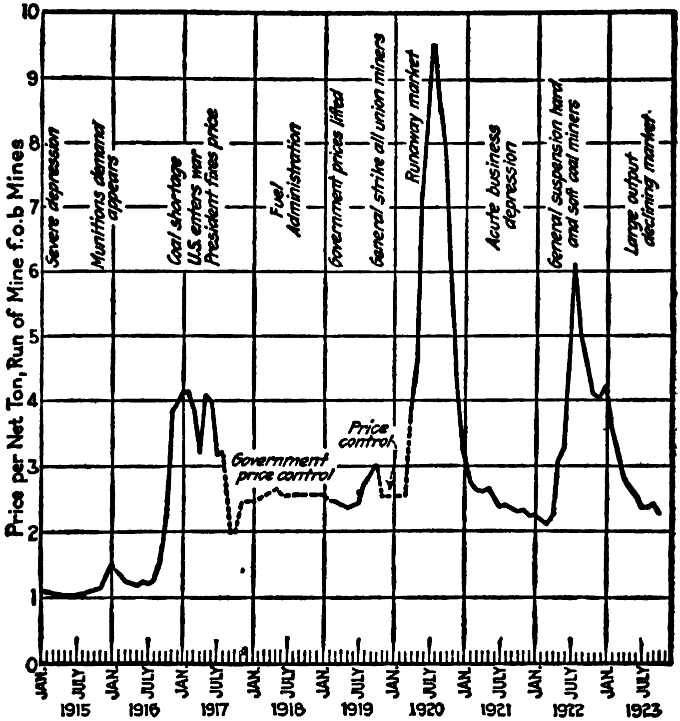


FIGURE 41 (SECTION 2). MONTHLY AVERAGE SPOT PRICE OF BITUMINOUS COAL, F.O.B. MINES, IN DOLLARS

in price does not add to the total supply reaching the consumer. If the mines are generally at work, the limiting factor becomes transportation, and further increase in price encourages the opening of thousands of wagon mines which, under the law, can demand transportation and whose activities so dilute the available car supply as to reduce the total quantity of coal handled by the carriers. Panic prices also discourage care in the cleaning of coal

and therefore encourage waste in transportation by requiring the carrying of more ash and dirt.

Forecasting the price of coal. Studies of the relation between spot price and consumers' stocks have shown that the price varies inversely with the amount of coal that consumers have in reserve.[1] Production alone does not control price. A drop in production does not seriously affect prices until it is registered in lower stocks. But a very high negative correlation between the consumers' reserve and the price is evident. A reserve below thirty million tons indicates a sellers' market; twenty million tons indicates a panicky market; and above forty million tons indicates a buyers' market. It is clear that consumers collectively have the power to make or break the bituminous coal market, and no single thing would be more conducive to cheap coal for American industry than the general practice of storage by consumers.

Changes in cost of production

It is characteristic of all business that during periods of prosperity costs increase, and during periods of depression they perforce decrease. The process of readjustment, or "deflation," as we call it, is painful. How does the bituminous industry readjust its costs to business depression? To answer this question, we may assume a condition of inflated costs and high prices and trace step by step the transition to lower costs.

Elimination of the marginal producer. The first sign of a declining market is the disappearance of wagon-mine coal. During the boom of 1920, at least 4400 wagon mines shipped coal in railroad cars. By April, 1921, practically all these little mines had closed. As prices

[1] Tryon and McKenney, *Economic Phases of Coal Storage,* United States Geological Survey.

further declined, the high-cost commercial mines were hard pressed to maintain themselves. Old commercial mines that are kept in operation beyond their normal, productive period during the times of high prices are closed and abandoned when prices fall. Before the European War, the "death rate" from the abandonment of worked-out mines was about 230 mines a year. In the depression of 1914, the rate increased to 265; during the War, it dropped to barely 200. With the collapse of demand after the Armistice, four hundred and fifty-eight mines were abandoned in 1919, and the record for 1921, though incomplete, will doubtless show a much larger number. Other high-cost mines, not yet ready to be abandoned, are forced to close. For a time they hang on, running one or two days a week and perhaps selling coal at less than the cost of production in the hope that the market will turn. A long depression forces them to close entirely. It was estimated that, at the trough of the depression in 1921, some twenty per cent of the commercial capacity of the country was shut down. In this process of elimination of the high-cost mine, the price of the product is the controlling factor. Other things being equal, the operator with low production cost appears to be more successful in holding business than the one with high-quality coal.

Changes in costs at well-established mines.[1] The region here considered includes only the coal-fields in the Northern Appalachian region, in Pennsylvania, Maryland, West Virginia, and Ohio. The information relates to the years from 1916 to 1922, inclusive, and covers the work of 127 operators, who produce about 40,000,000 tons annu-

[1] In preparing the data showing the cost of production and the investment in and profits on bituminous coal, use has been made of material contained in certain unpublished reports of the United States Coal Commission. (See Table 31.)

TABLE 31. PER TON COST, SALES REALIZATION, AND MARGIN OF 127 BITUMINOUS COAL OPERATORS IN THE NORTHERN APPALACHIAN REGION, 1916–22[1]

YEAR	TOTAL COST F.O.B. MINE	SALES REALIZATION	MARGIN PER TON	INDEX NUMBERS[a]	
				Total cost	Sales realization
1916	$1 12	$1 42	$0.30	100	100
1917	1 55	2 82	1.27	138	198
1918	1 95	2.70	.75	174	190
1919	1 95	2.43	.48	174	171
1920 (Jan.–Mar.)	2 23	2 70	.47	208	191
1920 (Apr.–Sept.)	2.69	3.95	1.26	240	278
1921	2 73	2 82	.09	244	198
1922	2 86	3.35	.49	255	236

[a] Average for 1916 = 100.0.

ally, or about fifteen per cent of the output in that region. Interpolations are made for 1919 and 1920 from the returns of 123 operators, 49 of whom are among the 127 operators. This period and this number of operators may seem, at first thought, insufficient to represent general conditions; but it must be borne in mind that what we seek to establish is a measure of the ebb and flow of the tide, not the depth and volume of the sea. These 127 operators felt, in common with the rest of the industry, this ebb and flow of the tide, and they are widely enough distributed to reflect differences due to differences in local conditions.

Figure 42 shows the course of their average, total f.o.b. mine costs, which rose from $1.12 a ton in 1916 to $2.86 in 1922, a rise of 155 per cent. The extreme fluctuations

[1] Identical operators, except for 1919 and 1920, for which years reports of 123 operators have been interpolated, of whom 49 were common to the group of 127 operators. Figures represent cost per net ton.

of the average receipts from sales contrast sharply with the steadier upward movement of costs. The highest point was reached in the period between April and September, 1920, when the sales realization averaged $3.95 a ton, or 178 per cent more than in 1916 ($1.42).

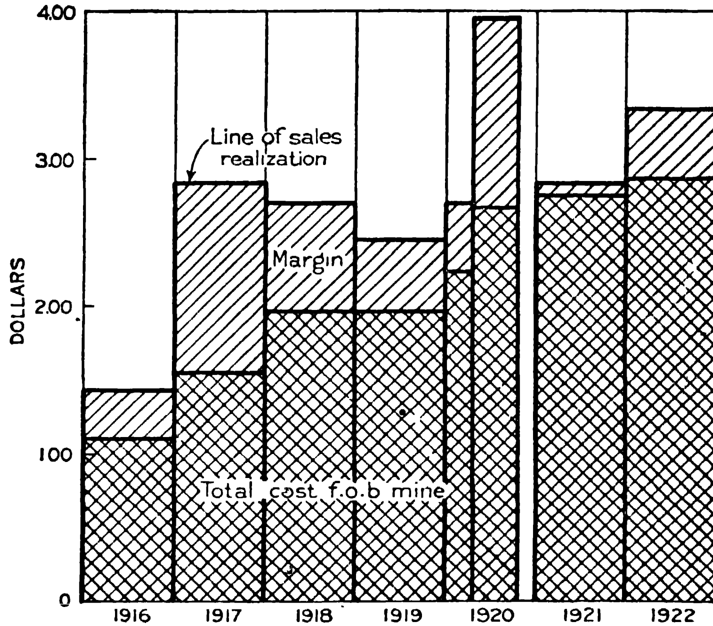


FIGURE 42. FLUCTUATIONS IN PER TON COST, SALES REALIZATION, AND MARGIN OF 127 BITUMINOUS COAL OPERATORS

(The operators shown are all in the Northern Appalachian region. They are identical for each year except 1919 and 1920, for which years reports of 123 operators have been interpolated, of whom 49 were common to the group of 127 operators.)

The labor cost per ton. Labor is the principal item of expense. The labor cost per ton must not be confused with the wage rates paid or the earnings of the workmen. The labor cost per ton during a specific period is the total amount paid out for labor, divided by the number of tons produced. The changes in labor cost are, therefore, a

resultant of several forces, which may act in the same direction or in opposite directions. The labor costs are affected chiefly by changes in wage scales and changes in rate of production. Other causes are changes in mining practice and in market demand and the attitude of labor. A marked increase in the rate of production may obscure for a time the effect of an increase in the wage scale.

Changes in labor costs from 1916 to 1922 at typical operations in six fields are shown in Table 32. In each of

TABLE 32. CHANGES IN THE PRINCIPAL ELEMENTS OF COST OF PRODUCTION OF TYPICAL OPERATORS IN 6 FIELDS, 1916–22

	PENNSYLVANIA		WEST VIRGINIA		OHIO	
	Pittsburgh	Central Pa.	Pocahontas	New River	No. 8 Seam	Cambridge
Number of Operators	14	14	20	22	10	5
1918 production	5,681,187	3,230,730	8,270,812	4,647,000	6,664,416	4,726,338
	LABOR COST PER TON					
1916	$0.78	$0.97	$0.55	$0.80	$0.78	$0.80
1917	1.04	1.29	.77	1.05	.98	1.03
1918	1.33	1.65	1.07	1.51	1.25	1.35
1921	1.82	1.99	1.66	2.29	1.71	2.06
1922	1.91	2.08	1.18	1.86	1.74	2.17
	SUPPLIES COST PER TON					
1916	$0.11	$0.07	$0.11	$0.13	$0.10	$0.08
1917	.24	.18	.18	.29	.19	.15
1918	.28	.29	.26	.40	.28	.20
1921	.37	.32	.38	.60	.25	.27
1922	.41	.34	.36	.42	.28	.24
	GENERAL EXPENSE PER TON					
1916	$0.23	$0.24	$0.21	$0.23	$0.14	$0.10
1917	.29	.32	.31	.34	.21	.18
1918	.31	.33	.30	.37	.25	.19
1921[a]	.62	.45	.43	.71	.34	.34
1922[a]	.79	.57	.43	.66	.48	.43

[a] Because of differences in accounting practice, the figures for general expense in 1921 and 1922 obtained by the Coal Commission are not strictly comparable with those for 1916–18, which were obtained by the Federal Trade Commission. The differences arise through the treatment of depletion and depreciation and tend to increase the figures for 1921 and 1922.

the six fields, labor costs have more than doubled since 1916, principally because of higher wage rates. That causes other than changes in rates may affect the labor cost per ton is evident from a study of the quarterly figures for 1921 and 1922 in the union fields of Pittsburgh, Central Pennsylvania, No. 8 Seam, and Cambridge, where there was no change in the official wage rates during those two years. To eliminate the effect that an increased rate of production would have in lowering labor costs, comparisons are made between periods in which the rate of production and the labor cost were higher, with periods in which the rate of production and the labor cost were lower. Thus, in the Pittsburgh field, 44 operators, who produced 33,500,000 tons in 1918, had a labor cost of $1.69 per ton during January–March, 1922, as compared with $2.02 in January–March, 1921. Their production decreased five per cent; their labor cost, sixteen per cent. In the Central Pennsylvania field, 122 operators, who produced 27,750,000 tons in 1918, had a labor cost of $1.86 per ton during October–December, 1921, as compared with $2.20 in January–March, 1921. Their production decreased one per cent and their labor cost fifteen per cent. Much the same condition is shown by the reports for the Ohio Number 8 and Cambridge fields.

Various reasons have been put forward to account for the lower labor costs in the face of a lessened rate of production and a stationary wage scale:

(1) Change in mining practice. Because of the slack demand during 1921 and the first quarter of 1922, much of the customary "dead work," or blocking out of rooms and passages for mining future coal, seems to have been curtailed.

(2) Abandonment of the practice of some operators of paying premiums over the union scale entered into in the summer and fall of 1920, when there was a brisk market demand and a need for miners.
(3) Voluntary increases in the amount of work performed by the miners made in order to lower costs, without reducing wage rates, and thus to help union mines to meet the competition of non-union mines, where wage scales had been materially reduced.
(4) Operators of more than one mine have closed down their higher-cost mines and limited production to their lower-cost mines until demand would warrant re-opening them.

Probably some or all of these causes were operating in one field or another. The examples chosen show that union operators were able to cut down, within certain limits, their labor costs in the face of a lessened rate of production, and without reducing the established wage rates.

In the two non-union fields of Pocahontas and New River, in West Virginia, though these causes may have reduced labor costs, the chief cause was the radical cuts in the wage rates in those fields in 1921 and in the first quarter of 1922. In the Pocahontas field, 40 operators, who produced 16,400,000 tons in 1918, had a labor cost of $.98 per ton in January–March, 1922, as compared with $1.05 for the year 1918. Their rate of production decreased six per cent and their cost seven per cent. In October–December, 1921, these operators had a labor cost of $1.33 as compared with $1.69 in April–June of the same year, with a decrease in their rate of production of five per cent and of the labor cost of twenty-one per

cent. Much the same condition is shown by the reports for the New River field.

Changes in profits

Operators' margins. Profits are included in a statement of the margins per ton, but in combination with certain other elements, such as the interest on borrowed money and the amount paid as Federal income and excess profit taxes. The margin is the difference between the cost of production and the average sales realization f.o.b. mine on all coal sold. It does not, therefore, directly indicate the net return to the owner of the business. And as the investment of different operations varies, so also does the margin necessary to profitable operation vary from operator to operator.

When the margins for the same operators, over a period of years, are compared, they throw considerable light on the variations in the profitableness of the business from time to time.

Figure 42 shows graphically the margins of the 127 operators in the Northern Appalachian region for 1916–22. The margin can be expressed in cents per ton, in per cent of sales realization, and in per cent of total f.o.b. mine cost. Margins for a series of years, expressed in cents per ton, are liable to lead to false deductions because of the changes that have taken place in the costs. For example, the margin shown for 1917 of $1.27 per ton was equal to eighty-two per cent of the cost, and forty-five per cent of the sales realization for that year. The margin of $1.26 per ton, shown for April–September, 1920, was equal to but forty-seven per cent of the cost, and thirty-two per cent of the sales realization.

According to the margins, the year 1917 was the most profitable period; April–September, 1920, was next;

and 1918, the third. The least profitable period was 1921.

Operators' returns on investment. Profits are included in a statement of the return on investment. What properly constitutes investment on which to compute profits, however, is an open question. Statistics are available for fifty-two companies in the Northern Appalachian region for the period 1913–22. These companies furnished detailed statements showing their investments, the income received, and many pertinent details. These companies produced about 45,000,000 tons a year (see Table 33).

TABLE 33. PROFITS AND INVESTMENT OF FIFTY-TWO LARGE OPERATORS IN THE NORTHERN APPALACHIAN REGION, 1913–22[1]

Year	Return on Stockholders' Equity		Return on Total Investment in Coal	Net Income per Ton of Total Investment in Coal	Index Numbers (1913 = 100.0)					
	With appreciation	Without appreciation			Production	Stockholders' equity		Total investment in coal operations	Borrowed money	Outside investments
						With appreciation	Without appreciation			
	Per cent	Per cent	Per cent							
1913	6.9	7.0	5.8	$0.18	100	100	100	100	100	100
1914	4.8	4.9	4.3	.15	90	102	102	103	104	101
1915	4.9	5.0	4.6	.14	100	104	104	102	104	103
1916	11.0	11.6	8.0	.25	112	111	106	112	109	111
1917	27.8	42.2	23.0	.91	104	159	106	134	106	182
1918	17.4	24.1	15.9	.74	98	107	143	148	98	298
1919	7.1	10.0	6.9	.35	88	202	144	144	99	346
1920	19.5	30.7	19.3	1.09	93	255	154	172	112	364
1921	4.7	7.0	4.9	.34	81	262	178	183	88	357
1922	4.6	6.7	4.7	.43	64	274	191	192	102	382

Figure 43 shows, in cents per ton for each year, the net income from the total investment of these companies in coal operations, represented both by stockholders' money and borrowed capital. It also shows the per cent of return each year on stockholders' equity (both in coal operations and outside investments) as it appears on the books,

[1] From United States Coal Commission Report on Investment and Profit in Bituminous-Coal Mining, not yet published.

and the per cent of return on this stockholders' equity less appreciation during the period through the revaluation of property, not only of the property used in coal mining, but of other investments. The figures show a great varia-

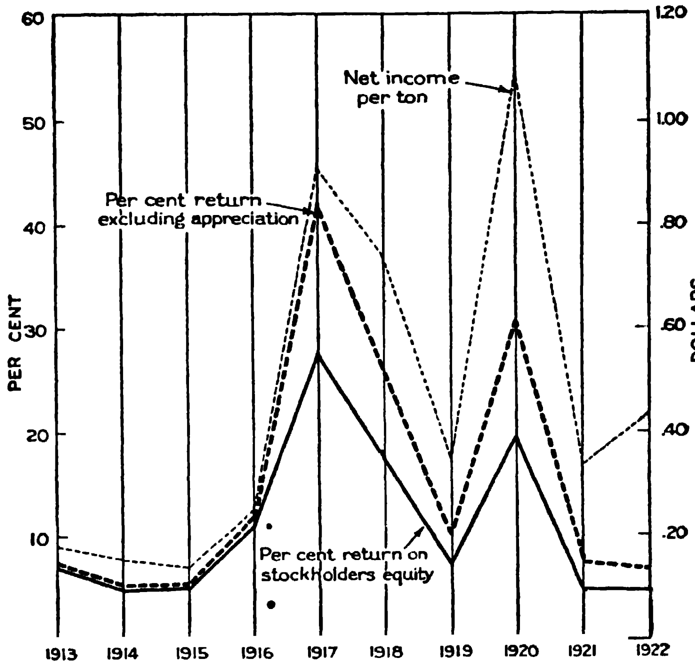


FIGURE 43. FLUCTUATIONS IN THE PROFITS OF 52 LARGE BITUMINOUS COAL OPERATORS

(The operators shown are all in the Northern Appalachian region. The data are from the United States Coal Commission Report on Investment and Profit in Bituminous Coal Mining, not yet published. The solid line represents per cent of return (before deducting Federal taxes) on stockholders' equity including appreciation of values of coal-bearing land and other assets. Deducting these appreciations of value, the income on stockholders' equity is as shown by the heavier broken line. The scale at the right is dollars per ton.)

tion in profits from year to year. The three years at the beginning and two at the end of the period show small returns, but 1917, 1918, and 1920 were years of exceptionally high profits. The profits were computed before deduction of Federal taxes.

Wholesalers' returns on investment. The Coal Commission obtained information for the ten-year period 1913–22 from eighty-four wholesale companies. Figure 44 shows the rate of turnover on the investment during each year,

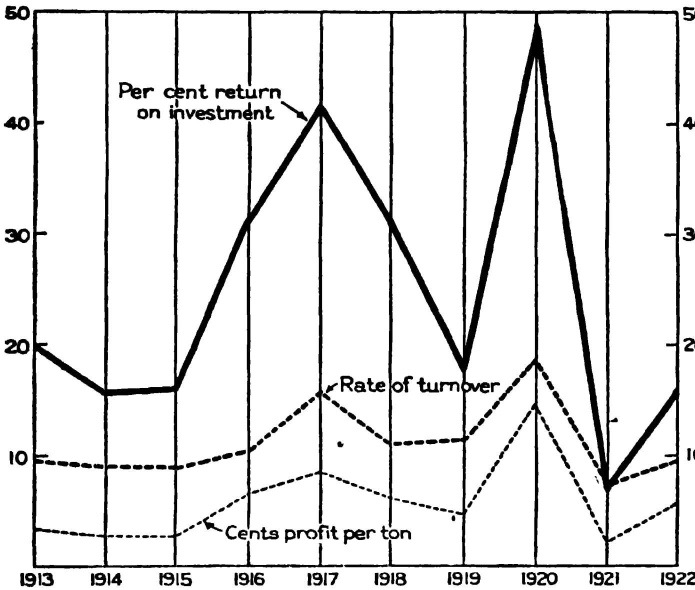


FIGURE 44. FLUCTUATIONS IN PROFITS OF 84 COAL WHOLESALERS

(Data from United States Coal Commission Report on Wholesale and Retail Coal Trade. Includes all companies reporting for each year of ten year period 1913–22, some of which handled anthracite. Profits are computed before payment of Federal Taxes.)

the per cent of return on the investment, and the "direct profit," which here corresponds in a general way to the margin shown for the operators. The years of highest returns for the wholesalers, as for the operators, were 1917, 1918, and 1920 (see Table 34). These high returns on investment, though the return per ton handled is so much smaller, relatively, than that received by the operator, are made possible by the frequent turnover of capital by

TABLE 34. COSTS AND PROFITS OF EIGHTY-FOUR COAL WHOLESALERS, 1913–22 [1]

YEAR	RATE OF ANNUAL TURN-OVER (times)	PER CENT OF BORROWED MONEY IN TOTAL INVEST-MENT (per cent)	RETURN ON TOTAL INVEST-MENT (per cent)	EX-PENSES PER TON (cents)	DIRECT PROFIT PER TON (cents)	TOTAL INVEST-MENT PER TON (cents)	INDEX NUMBERS (1913 = 100.0)	
							Tonnage handled	Total invest-ment per ton
1913	9.7	26.6	19.9	6.0	3.4	18.7	100	100
1914	9.1	25.9	15.8	6.9	2.8	20.1	97	104
1915	8.9	30.6	15.9	6.6	2.9	20.3	107	116
1916	10.3	29.7	31.3	6.5	6.3	21.2	124	141
1917	15.8	21.0	41.8	8.7	9.2	22.9	126	154
1918	11.2	21.0	31.1	8.0	6.1	24.7	121	160
1919	11.7	26.6	18.0	10.4	4.8	30.9	103	170
1920	18.4	18.8	49.0	14.0	14.3	30.9	121	201
1921	7.2	24.6	6.6	14.9	2.1	52.1	90	251
1922	9.6	16.5	15.6	13.7	5.7	43.1	98	225

the wholesalers, their investment per ton handled during 1917–22 being around thirty cents as compared with about $5.50 per ton for the fifty-two operators during the same period. The profits were computed before deduction of Federal taxes.

Comparative range in profits of operators, wholesalers, and retailers. Though it is not possible from the data here presented to establish the comparative average level of wholesale, retail, and mining profits, it is possible to note in which of the three branches of the trade the fluctuations in profits have been the sharpest in recent years. The variations in average profit between fat and lean years is apparently greatest for wholesalers, somewhat less for operators, and least for retailers. (Figure 45.) The greater steadiness of retail profits is largely due, no doubt, to the fact that domestic consumption of coal, which fur-

[1] Data from United States Coal Commission Report on Wholesale and Retail Coal Trade, by J. W. Adams. Includes all companies reporting for each year of period, some of whom handled anthracite.

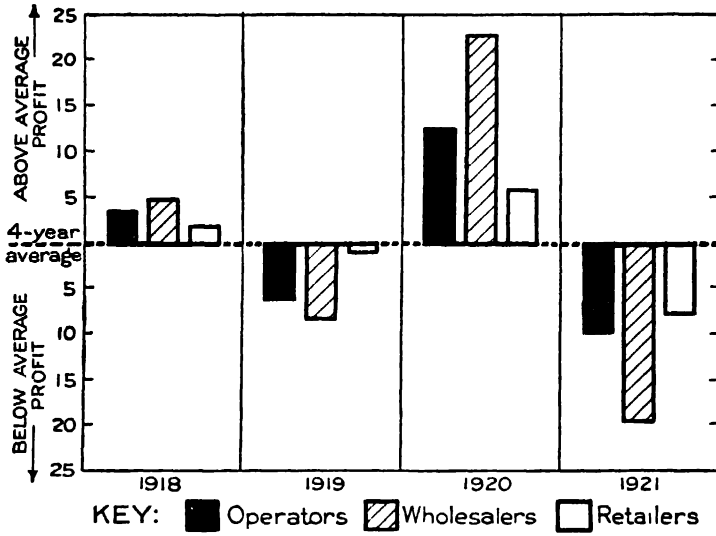


FIGURE 45. COMPARATIVE RANGE IN YEARLY PROFITS OF BITUMINOUS COAL OPERATORS, WHOLESALERS AND RETAILERS

(In the bituminous coal industry, fluctuations in average profit between good and bad years are greatest for wholesalers, somewhat less for operators and least for retailers. The bars in the diagram show the variation of the profit for each of the three groups above or below the group average for the four years 1918–21, which is represented by the dotted base line.

The data for operators are from the *unaudited* Federal tax returns of 1234 bituminous coal producers, and represent per cent of net income to invested capital before deducting tax.

The data for wholesalers are for 84 identical companies, including a few companies handling chiefly anthracite, reporting to the United States Coal Commission. The data represent return on total investment.

The data for retailers are for 118 companies in the Central, Southern, and Far-Western States, regions where retailers handle chiefly bituminous coal, and represent return on total investment.)

nishes the bulk of the retailers' business, is steadier than is industrial consumption, in which the operator and wholesaler are chiefly interested.

Readjustment of labor during depression

Mine workers share with mine operators the burden of the depressions. A depression always results in less work for the men. The average number of days worked by the mines dropped to 193 in the depression year of 1908. In

1914, it fell to 195 days, and in 1921, to 149 days. Sometimes the depression results in a reduction in the total number of men employed in the industry, as in 1911, and 1914–15. At other times, however, the number of men employed increases during a depression; in 1921, it increased notably. This seeming paradox of a greater number of employees in a year of profound depression is explained by the almost universal custom of part-time operation at the mines. As long as the owner attempts to run at all, he prefers to have a full crew; and, if labor becomes plentiful, he may take on additional men on piece work. He may not have orders enough to warrant operating more than one day a week, but as the whole industry is accustomed to irregular work, he runs his mine on that one day with a full force. If the depression is prolonged, however, many hundreds of mines close entirely, and until they reopen the men dependent upon them may have no chance to work at all.

Productivity of labor during a depression[1]

It is a part of the accepted theory of business cycles that the efficiency or productivity of labor is diminished in times of great prosperity and reëstablished in times of depression. The theory runs that when work is plentiful and wages are high, workmen become careless, employers are forced to take on inefficient men, the power to discharge cannot be exercised, discipline is relaxed, and there may be deliberate soldiering on the job or restriction of output. Conversely, the theory runs that during a depression, the less efficient men are dismissed, those who remain work harder, shorter hours prevent fatigue from limiting productivity, discipline and attendance improve,

[1] See Table 35 for changes in productivity of mine labor in prosperity and in depression.

TABLE 35. CHANGES IN PRODUCTIVITY OF LABOR IN BITUMINOUS MINES AS INDICATED BY TONS PER MAN PER DAY[1]

YEAR	TOTAL UNITED STATES	OHIO	INDIANA	ILLINOIS	PENNSYLVANIA	COLORADO	WEST VIRGINIA	KENTUCKY
1900	2.98	3.20	2.78	2.92	3.56	2.66	3.36	2.4
1901	2.94	3.29	2.75	2.97	3.53	2.54	3.55	2.4
1902	3.06	3.02	2.98	3.08	3.52	3.16	3.38	2.3
1903	3.02	3.05	3.22	3.21	3.40	3.28	3.36	2.5
1904	3.15	3.20	3.14	3.13	3.70	3.14	3.49	2.7
1905	3.24	3.35	3.11	3.29	3.57	3.14	3.74	2.8
1906	3.36	3.65	3.30	3.49	3.68	3.32	3.86	2.9
1907	3.29	3.45	3.38	3.59	3.61	2.94	3.54	3.0
1908	3.34	3.44	3.85	3.79	3.51	3.13	3.98	3.2
1909[a]	..	..	..	..	..	.	..	..
1910	3.46	3.61	3.67	3.95	3.61	3.20	3.94	3.2
1911	3.50	3.73	3.68	3.73	3.69	3.42	4.05	3.1
1912	3.68	3.77	3.88	3.95	3.89	3.72	4.31	3.3
1913	3.61	3.83	4.06	4.10	3.78	3.36	4.07	3.5
1914	3.71	3.84	4.27	4.18	3.75	3.32	4.52	3.7
1915	3.91	3.94	4.17	4.35	4.00	3.60	4.89	4.1
1916	3.90	4.26	4.48	4.42	3.91	3.43	4.68	3.9
1917	3.77	4.26	4.52	4.22	3.80	3.33	4.35	3.7
1918	3.78	4.24	4.45	4.37	3.81	3.36	4.22	3.5
1919	3.84	4.41	4.72	4.48	3.96	3.88	4.18	3.4
1920	4.00	4.73	4.86	4.78	3.96	3.51	4.39	3.9
1921	4.20	4.60	4.86	4.80	4.03	3.83	4.79	4.1
1922	4.28	4.92	5.19	5.05	3.84	3.87	5.10	4.8

[a] No data for 1909.

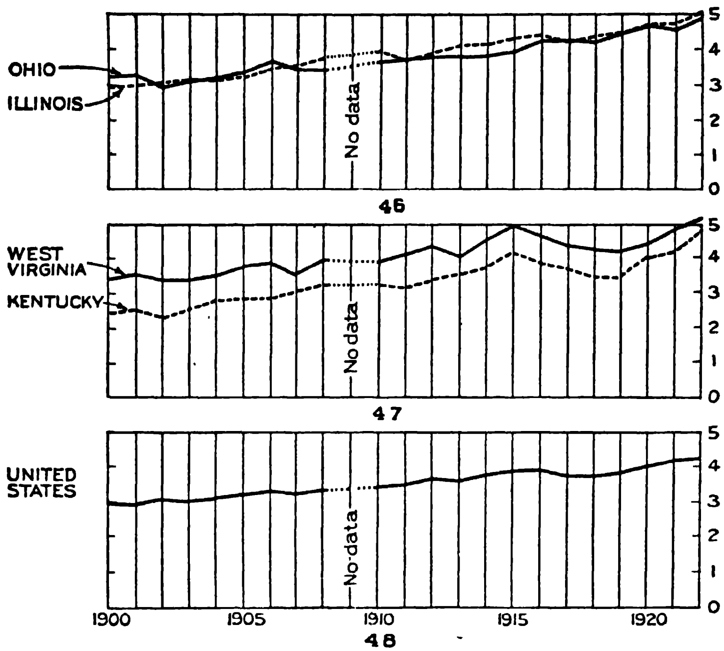
and in other ways the quality of service is raised. This theory is supported by a very considerable body of expert opinion and evidence from employers, labor managers, and students, but it is difficult to establish quantitatively. For the coal industry, however, there exists a mass of quantitative evidence which should go far to measure the efficiency of labor in the alternating booms and slumps of the business cycle.

[1] Computed from reports of operators to the United States Geological Survey by dividing the total production in tons by the product of the average number of days worked by the mines, and the average number of men employed.

The measurement of output per man is relatively simple in the coal industry, because the product can be measured so easily. The statistical records of the Geological Survey cover for each year the total production in tons, the average number of men employed, the average number of full-time days worked by the mines, and the length of the established working day. By dividing the total output by the product of the number of men employed in the mines and the number of days worked by the mines, we obtain the average output per man employed per day worked. The quotient is not the output to be expected from a tonnage worker doing a normal day's work; it is not even the average output per man-shift, because no allowance is made for absenteeism. The average is not an engineering observation but an arithmetical computation, and the original returns upon which it is based contain a good many errors. With due allowance for these defects, the average per man per day still has unique value, because the errors are probably constant from year to year and because, therefore, change in the average shows the trend clearly.

Figures 46–48 show the course of this average for some of the large coal-producing States from 1900 to 1922. All the curves of the chart have an upward trend, indicating steady increase in the production per man per day. This does not mean, necessarily, that the coal miners worked harder in 1923 than they did in 1903, nor that they were more skillful. The primary reason for the increase is rather the steady introduction of mining machines, the improvement of equipment, and other advances in the art of mining. The curves show simply that the sum total of plant, labor, and management now produces much more per unit of labor expended than it did 20 years ago.

Between the figures for one year and those for the next, however, the change introduced by improvement in technique is so small that it may be disregarded; and, if there



FIGURES 46, 47, 48. TONS OF BITUMINOUS COAL PRODUCED PER MAN PER DAY, 1900–22

(Computed from reports of operators to the United States Geological Survey, by dividing the total production in tons by the product of the average number of days worked by the mines and the average number of men employed.)

is any great variation in the attitude of the men toward the job as shown in their diligence and industry, we should expect to find it expressed in sharp fluctuations in the curve between years of activity and high earnings and subsequent years of dullness and low earnings. But, as a matter of fact, the curves are singularly regular. Those for Ohio and Illinois (Figure 46) show a steady increase,

and the small irregularities are probably as much the result of errors in the data as of any great change in the efficiency of the men.

The curves for the non-union States of West Virginia and Kentucky, shown in Figure 47, at first sight appear to bear out the theory of change in efficiency of labor. Both curves show an increase in 1914 and 1915, which were years of general depression, and a quick decrease in the boom years 1916–18. But this apparent drop is largely explained by the adoption of the eight-hour day. In 1916, practically all mines in West Virginia worked nine hours, or longer. By 1920, practically all had made the change to the eight-hour day. The weighted average workday for the State in 1916 was 9.4 hours. The weighted average workday in 1917 was 8.5 hours, and by 1919 it had dropped to 8.1 hours. This change in the length of the unit of time is just about equal to the reduction in output per day. It is this change in the length of the working day in the non-union fields that accounts for the slight depression in the curve of output per man per day for the country as a whole from 1916 to 1919, shown in Figure 48. There was a slight decline in output per man per day in the boom year 1907, and a corresponding increase in 1908, but both changes are so small that they may well be due to some error in the figures rather than to a change in the attitude of the men.

There are, however, certain factors that tend to raise the output per man in a year of depression. These include closing of the less efficient high-cost mines, increase in the percentage of machine-mined coal, and the tendency of operators to postpone development work. How much they tend to increase the average cannot be stated with precision, but any allowance for them leaves small room in the figures for any variation in the efficiency of the in-

dividual worker. The evidence, so far as it goes, appears to show that, in a broad sense, the miners turn out just about as much coal per shift in one year as in another. In partial explanation of this lack of variation may be cited the fact that the manager of a coal mine does not discharge the less efficient workers during a depression. They may be transferred from day work to tonnage work, but, so long as the mine runs at all, the operator is generally glad to keep them on the roll. For this reason, manufacturing might show an increase in output per worker during a depression when coal mining did not. The conclusion suggested by these broad statistical averages should be tested by intensive studies of individual mines. The problem deserves attention from the engineers.

To avoid misunderstanding, we wish to make it clear that we are here attempting no comparison of productivity under union and non-union conditions, but are concerned solely with the question whether the output per man rises or falls with the changes of the business cycle.

Increase in mine capacity following periods of prosperity

We turn now to another phase of the business cycle in coal mining — the effect of a period of prosperity in stimulating new development, thereby increasing the intensity of the subsequent depression. Every period of high prices leads to the opening of new mines, and the effect is greatest when, as in 1916–18, the increase in price lasts over a considerable period. The full effect of the increase in price, however, may not be apparent for years. After an operator decides to open a new mine, some months must elapse before he can load his first coal, and it may be three years, or even longer, after ground is broken before the property is producing at its maximum rate. A sudden increase in capacity, therefore, may not become effective

until the market conditions that brought it about have passed and given place to depression. How this works is well illustrated by the growth of mine capacity during the War period. The normal annual "birth rate" before the War was about three hundred new mines of commercial size. In their first year of production, these mines would turn out perhaps eight million tons of coal, but by the third year of their life the same mines would turn out eighteen or twenty million tons. As soon as the price shot up in 1916, the "birth rate" greatly increased. In that year, 454 new commercial mines were opened; and in 1918 the number jumped to 1573. In this connection we should not forget that the Government's price policy deliberately encouraged new development. The first-year output of the mines that were opened in 1918 was twenty-four million tons, and their mature output was probably well over fifty million tons. The figures of new and abandoned mines show that the properties opened in the three years, 1916–18, so far exceeded those abandoned during the same time as to add at least one hundred and fifty million tons to the annual capacity of an already overdeveloped industry. But these increments in capacity did not greatly affect the market until the high price of the War had gone. This was partly because of the time required to bring new mines to maturity and partly because, when they were projected, there was no surplus of labor to man them. In fact, much of the new capacity came into mature productivity in the depression year 1921, during which the producing power of the industry increased by sixty-four million tons. In this way, the accumulative tendencies of a period of prosperity are carried over into a period of depression, rendering the depression thereby more acute. If the bituminous-coal industry wishes to avoid the distressing experience of

1921, it must find some way to control expansion during a boom such as that of 1916–18.

Fortunately for the immediate future of the industry, it does not appear that the high prices of 1920 and of 1922 were so effective in causing new development as those of the War period. The coal crisis of 1920 was of comparatively short duration; and, for the few months it lasted, the profits were so large that operators bent every effort to produce coal for immediate sale rather than to open new mines.

As another phase of this subject, it is to be noted that, by reason of the flexible wage costs of non-union fields, they may be initiating new development at the very time when union fields are shutting down for lack of market, that condition having actually existed in 1921.

Increase in productive facilities arises not merely from the opening of new mines. The steady introduction of mining machines in the existing mines, electrification of haulage, improvements in hoist and tipple, modernization of layout, and other mechanical improvements are accelerated by prosperity and increase capacity. That these factors were very active through the War period is clear from the trend in output per man per day, which has largely increased even at the mines in existence in 1913.

This analysis of the reaction of the industry to the booms and slumps of business may seem to have little relation to forecasting. It has, however, disclosed a controlling influence in the outlook for the industry, even in the future immediately at hand. That influence is the greatly inflated capacity, which points to intense competition and a struggle for survival of the fittest among mines, except as some interruption to supply, such as a general strike or severe car shortage, may increase the price.

CHAPTER XVI

FORECASTING AGRICULTURAL CONDITIONS

By HENRY C. TAYLOR

SINCE we are living in a dynamic society where economic conditions and consequently prices and price relations are ever changing, it follows that our decisions and business judgments are based largely upon forecasts. A forecast is a statement of what may be expected to happen, based upon present conditions and observations, interpreted in the light of previous experience; and it is the basis of deciding what action to take in order to secure a desired end. A scientific forecast is one made on the basis of a discovered systematic sequence of normal experience.

Farmers of necessity must think in terms of future possibilities. In the light of their knowledge of the physical and economic environment, they decide what they will undertake to do for the coming year — how much land they will use, the acreage they will put into each of the various crops, and the live stock they will keep as a part of the farming operations. Farmers are not the only ones who make agricultural forecasts. Many merchants who deal in farm products give even more attention to agricultural forecasting than do farmers. In so far as the economic factors are concerned, farmers too generally determine how much they will produce next year of a given crop on the basis of present prices rather than prospective prices. As a result they have often planted high-priced seed, and used high-priced fertilizer, labor and land in increased quantities, and sold the increased quantities of product at low prices and, in turn, planted lightly of low-

priced seeds and used little fertilizer and had a small production to sell at high prices.

The buyers of farm products take into account not only available supply, but the probable future supply of the product which may be forthcoming. If there is a ten per cent surplus of the product of one year to be carried over to the next year, the buyer of this surplus naturally bases the price he is willing to pay upon the probable price he will be able to secure the next year; and this he bases on the forecast of what will probably be produced the next year.

While forecasts have always been made by farmers and merchants and will continue to be made, it is believed that agricultural forecasting can be made more accurate by making statistical analysis of historical data, in an attempt to discover a systematic sequence of events, and to determine the variation in, and probable error of, this routine of experience. Also the collecting of materials and data will add greatly to the usefulness of our forecasting base. Furthermore, knowledge of the intentions of others, who likewise are contemplating the making of readjustments, will improve the basis of passing judgment. The purpose of agricultural forecasting is the wise guidance of production in order that there may continue to be a proper balance between the various lines of production and between agriculture and other industries. Agricultural prosperity in general depends primarily upon the ability of farmers to anticipate the future.

Forecasting can be viewed not only from the standpoint of the individual farmer and the merchant dealing in farm products, but also from the national point of view — the supply of food and raw materials for the Nation throughout a series of years. From the individual point of view, forecasting is the basis of wise farm and

marketing practices. From the national point of view it is the basis of a national agricultural policy.

The Department of Agriculture is progressively improving the basis of agricultural forecasting. The estimating of the acreage of crops that had been planted and the condition of crops at given periods while in progress of growth naturally led to forecasting the resultant in bushels or bales. These forecasts were particularly valuable from the standpoint of adjusting prices on the basis of probable supply and demand. In the absence of knowledge of the prospective supply, prices may be very much too high or very much too low, for it is not supply and demand, but what people think the supply and demand are, or will be, that makes prices. The more accurate the forecast, the more steadily we may pass from the sale of one year's crop to another without violent price fluctuations.

Whatever advantage there may be to the farmer, in selling his product, to know the amount which has been produced, it is not to great advantage to him at planting time in determining what changes he should make in his production with a view to securing a satisfactory return for his efforts. With a view to giving more intelligent direction and greater stability to agriculture in this unsettled period when readjustments are in danger of resulting in violent movements from one line of production to another, estimates have been made of farmers' intentions to plant the various crops or to breed the various kinds of live stock. The idea has been to secure this information and publish it early enough to give farmers opportunity to make changes in their plans. It is important not only that farmers have a knowledge of what their fellow farmers are planning to do in the way of increasing or decreasing given lines of produc-

tion which may affect the supply side of the equation, but also it is important to have some forecast on the demand side of the equation. I shall attempt to describe, briefly, some of the efforts which have been made to give the farmer better information both in respect to probable supply and probable demand, as a basis of determining his line of action in the production and marketing of his products.

Estimates of the number of spring pigs raised give the basis for forecasting the number of hogs which will appear in the markets during the following fall and winter. In June, 1922, the first spring pig estimates were made. The information for this report was gathered in coöperation with the Post Office Department through its rural mail carriers, who secured reports from over two hundred thousand farmers in the Corn Belt States. These reports showed an increase in spring pigs over the previous year of 22.8 per cent for those states. The receipts at the stockyards for the period beginning in October of that year when the spring pigs started to market and ending in April when the bulk of this crop of pigs had been marketed, showed an increase of twenty-three per cent over the previous year. A similar report was made in December, 1922, which showed an increase of twenty-one per cent in fall pigs, which agreed exactly with the increase in receipts at the stockyards during the next summer, when these pigs reached the market.

The first "intention survey" was made in connection with the pig estimates of June, 1922. This report showed an intention on the part of farmers to increase breeding for fall litters to the extent of forty-nine per cent above that of the previous year. As one studied the situation, this was what should have been expected from the price relations which existed between corn and hogs. Hogs had

been high in proportion to the price of corn; and any one who has studied price trends for a series of years knows the tendency of farmers to overdo hog production when hogs are high relative to corn, and to overdo corn production when corn is high relative to hogs. With these facts in mind, cautions were issued in 1922 against such a large increase in the fall pig crop. Whether these cautions had any influence or not, it is true that the actual number of sows farrowing in the fall of 1922 was twenty-eight per cent above that of the previous year, instead of forty-nine per cent as was originally indicated. The December report also showed an intention to breed 13.1 per cent more sows for spring pigs, while the actual increase in breeding, as reported June, 1923, was only 3.9 per cent. The report made in June, 1923, also showed an intention to increase the number of hogs bred for fall pigs by 28.3 per cent. This fact was given wide publicity, and judging from the receipts of sows at markets, it is to be expected that when the next survey is issued, it will show, most likely, that this intended increase has been very materially reduced, if it has not altogether disappeared.

The objective of the Department of Agriculture in these reports is to give such information with regard to farmers' intentions to produce hogs and plant corn on the one hand and the world market conditions on the other, as will enable them, in the light of the knowledge of what has happened in the past with regard to violent fluctuations in the relations of the prices of hogs and corn, to forecast the true situation, and maintain a proper balance between hogs and corn.

Not only is the Department reporting the intentions of farmers with respect to the number of brood sows they are planning to keep, but it is making reports on the in-

tentions of farmers to plant crops. Reports covering spring-sown crops, issued in April, 1923, indicated the intentions of the farmers with respect to planting cotton, corn, spring wheat, oats, tobacco, etc. Upon an examination of the reports on intentions to plant, compared with estimates of actual planting issued later, it was found that there was rather a close resemblance in most of the crops, tobacco excepted, between the figures showing the intentions to plant and the figures showing estimated planting. These reports should, of course, resemble one another, except when they show that readjustments are needed because of a tendency to over- or underplant.

The figures shown by the intentions survey were considered by the Committee on Agricultural Outlook, which met in April, 1923. When they considered these figures, they looked upon the increase of ten per cent in the tobacco acreage over the previous year, with its accumulative effect, owing to the fact that it was also fifty-five per cent above the pre-War average. They then gave a definite warning to tobacco producers, as follows: "There is nothing in the probable demand sufficient to offset the contemplated increase of ten per cent in planted acreage, particularly when we consider that the 1922 acreage was above the normal, and that the trend of prices since 1920 has, on the whole, been downward." Whether or not this statement was the occasion of the change in the farmers' idea of what to do, the July estimate showed an increase in tobacco acreage of only 2.1 per cent instead of ten per cent.

The purpose of the committees on Agricultural Outlook was not only to make a forecast based upon the best materials the Department of Agriculture was able to assemble, and such evidence as the several members of the

committees were able to bring with them, with regard to the trend of affairs in the production of certain crops and certain kinds of live stock, but also to make a statement regarding the outlook with respect to demand for farm products. It is believed that statisticians and economists who are continually studying world economic relations, and who should have the composite judgment of large numbers of business men throughout the country with regard to what will probably happen in the relatively near future in business conditions, can add greatly to such material as the Department of Agriculture can secure in providing a basis of judgment for the American farmer upon which to plan his next season's work.

The second estimate of intentions to plant was made in August, 1923, covering fall-sown crops, and was followed by the report of the second committee on the Agricultural Outlook. In the main, the reports of the two Agricultural Outlook committees have been received with favor. It will take some time fully to develop the reports on Agricultural Outlook; but it is believed that in the course of a few years these reports can be very much improved, and farmers will learn how to make use of them in such a way as to make this phase of agricultural forecasting extremely valuable to the American farmer.

Students of this problem will be interested to know that among the important projects which the Bureau of Agricultural Economics has under way is one designed to furnish a method of presenting statistics of supply and demand which will make it possible more accurately to determine the significance of these statistics as indicators of current price conditions and price conditions of the immediate future. Price changes do not exactly coincide in time with changes in underlying supply and demand con-

ditions. Weeks and perhaps months may elapse before a shortage or an oversupply of any farm commodity is reflected in a change in its price. The Bureau is attempting, from a study of price, production and business statistics, to determine what is the normal "lag" in the case of leading agricultural products between changes in the supply and demand conditions and changes in price. Results already attained indicate that the effort will be successful. Studies of price movements of hogs and cotton show that certain demand and supply figures anticipate the price movements several months in advance with remarkable uniformity. Investigation into price movements in other lines is expected to show similar uniformity.

The systems and methods of forecasting which I have been discussing have reference largely to the problem of throwing more light on the immediate trends in conditions that determine the prices of crops and live stock. It is also highly important to be looking ahead in order to determine the long-time trend with respect to agricultural development. It may be true that the long-time trend is obscured by existing short-time trends. For instance, the temporary depression in the prices of certain farm products makes it appear that farm land is superabundant, and has tended to make the public forget the steady decrease for more than two decades in the acreage of crops and live stock per capita.

Recognizing the importance of considering the long-time trend, the Secretary of Agriculture has appointed a special committee on Land Utilization. The committee is bringing together the facts with regard to the past trend and the future outlook during the next three or four decades with respect to crop and pasture acreage, per capita and total consumption, exports and imports, and changes in productivity per unit of land area. These

lines of study are being focussed on the objective of trying to determine the probable requirements of land for crops, pasture, and forests, for it is recognized that these three uses are to some extent competitive for our available land area. The committee is also studying the adaptability for the three uses mentioned of the land not now in crops.

Closely related to the task of long-time forecasting, is the problem of looking ahead with reference to the probable course of prices of agricultural products and the prices of farm real estate. Such forecasts are important not only in order to enable farmers to invest wisely and plant correctly, but also in order to aid mortgage bankers, land settlement agencies, and other business concerns which are compelled to risk billions of dollars under conditions of extreme uncertainty as to the future course of the basic economic conditions which determine the security of their investments.

Like all kinds of forecasting the attempt to study the long-time trends is subject to the uncertainty of future events, but in some regards probably to no greater extent than is the case with short-time forecasting. At any rate, the long-time forecast provides a well considered outlook on the probabilities, and an intelligent basis for determining state and national policies with respect to immigration, foreign trade in farm products, forestry, reclamation, and land settlement.

While agricultural forecasting by public agencies is a new thing, substantial progress is being made; and it is believed that if the work in this field is confined largely to the collection and dissemination of facts which give the basis of judgment on the part of farmers and others in making decisions for themselves, the benefits will be very great. It will put farmers as a class more nearly on an even basis with those in other industries in deciding whether

to continue in accordance with their old plans or to readjust their production, owing to permanent changes which may have taken place in marketing conditions. Thoughtful students should give careful attention to this new field of work.

CHAPTER XVII

FORECASTING CORN AND HOG PRICES

By H. A. WALLACE

THE corn-hog industry is the outstanding characteristic of the agriculture of the Corn Belt of the United States. It is because of the corn-hog industry that Iowa, Illinois, Indiana, western Ohio, eastern Nebraska, northern Missouri, southern Minnesota, and southeastern South Dakota, in other words the Corn Belt, is the richest large agricultural region in the world. The corn-hog industry ranks with wheat-growing, cotton-raising, and steel-manufacturing as one of the leading, fundamental, productive activities in the United States.

Corn and hogs are closely interrelated because of the fact that hogs consume forty per cent of the corn. Dot hog maps and dot corn maps of the United States are very similar in appearance, except for the fact that in central Illinois they do not seem to raise as many hogs as the corn production would warrant, and on the Pacific coast they seem to raise more hogs than would be expected from their corn production. Generally speaking, however, those sections of the country which produce large quantities of corn also produce large quantities of hogs.

For forecasting purposes, corn prices are much more valuable as a barometer of oncoming hog prices than are hog prices as a barometer of future corn prices. Because of this situation, we shall study corn prices first. In the first place, corn prices, over any considerable period of time, seem to have a fairly definite relationship to the general price level. For instance, if we express the relationship between farm corn prices and the general United

States price level as 100 for the decade 1906–15, then the relationship during the twenty years extending from 1866 to 1885 was 79, during the decade of 1886–95 the relationship was 88, and during the decade 1896–1905, 87. Previous to 1915 there was a tendency for corn prices to rise slightly more than prices generally; but, on the whole, over any period of five years or more, there was a fairly constant relationship. The chief cause for corn prices varying from their normal relationship with the general price level has been the varying size of crop, and this in turn has been due almost altogether to the character of the weather during the six summer months. As a rule the corn acreage does not vary much from one year to the next; and the matter of supreme importance therefore, in determining corn prices, is the average acre yield. In Nebraska, Kansas, Missouri, southern Iowa, Illinois, Indiana, and Ohio, multiple regression lines, or forecasting formulas, have been worked out between the acre yield of corn and certain factors which have a multiple correlation coefficient of around .7; and in the case of Illinois and Kansas of over .8. Those who are interested in the statistical details of predicting corn yields from the weather, may find it interesting to consult, in the August, 1920, Weather Review, an article on a mathematical inquiry into the effect of weather on corn yield in eight Corn Belt States. More recently I understand that J. Warren Smith and J. B. Kincer, of the United States Weather Bureau, have gone into this matter in more refined fashion, and that they have hopes of developing predicting formulas for forecasting corn yields from the weather which will have a correlation with the yields, as estimated by the United States Bureau of Agricultural Economics, of better than .9.[1]

[1] See Chapter XVIII, below.

Briefly, the ideal corn season in the central part of the Corn Belt is about as follows: May, 65° mean temperature and 3.5 inches of rain. When damage is done to the corn yield in May, it is usually because of too much cold and rain, and this is especially true in the northern part of the Corn Belt. A mean temperature of less than 56° in the month in which corn is planted may often reduce the yield very materially. The ideal June temperature for corn is a 71° mean and the ideal rain about 3.5 inches. A moderately dry June is desirable so that the corn cultivators can do their work in killing the weeds most effectively. Over the greater part of the Corn Belt the really important corn weather is between July 8th and August 7th. During this thirty-day period, on land capable of producing forty bushels per acre under favorable conditions, each degree the mean temperature averages above 75° cuts the corn yield by about 1.2 bushels per acre, and each inch the rainfall is below four inches cuts the yield by about two bushels per acre. In case the soil is in unusually good tilth and there is a plentiful reserve moisture supply in the soil, a rainfall of 2.5 or three inches may be sufficient at this critical period for an optimum yield. Mean temperatures above 78° during this period would not necessarily be very injurious, except for the fact that they are almost invariably accompanied by drouth. Moreover, the average corn plant transpires nearly twice as much moisture at a mean temperature of 80° as at a temperature of 70°.

A study of December future corn prices, as they vary day by day on the Chicago Board of Trade during July, indicates that the speculators are fully aware of the effect of heat and drouth on the new corn crop. Unless unusual economic forces are at work, it takes on the average about one inch of rainfall every ten days during July and early

August to hold the December future price of corn steady on the Chicago Board of Trade. More than one inch of rainfall every ten days tends to lower corn prices, 1.4 inches or more tending to cause a drop of two or three cents a bushel. Less than one half inch of rainfall in ten days tends to cause an advance of three or four cents a bushel. If there has been an average of less than a tenth of an inch of rainfall over the Corn Belt during the ten-day period, and if the mean temperature has averaged above 80°, the December future corn price may run up by more than five cents a bushel.

Much ado has been made over widespread July rains. They have been called "million-dollar rains" because presumably they added that much to the purchasing power of the farmers. As a matter of fact, the rain which increases the prospective corn crop of the Corn Belt by a hundred million bushels, or by seven per cent, will ordinarily lower the price of new crop futures by six to twelve per cent. The farmer who has cause for genuine rejoicing is the man who gets more rain than his neighbors, or who feeds more corn than he raises.

Statistical research indicates that corn prices before the War, on farms of the United States on December 1st, varied up and down according to the size of the crop about as follows: A crop of twenty per cent below normal meant a price thirty per cent above normal, whereas a crop only ten per cent below normal meant a price about fifteen per cent above normal, and a crop ten per cent above normal meant a price about eight per cent below normal. The negative correlation between the average acre yield of corn and the price is about .8. Other things besides size of crop have some influence on corn prices. This residue, which cannot be accounted for by size of crop, seems to be determined about four per cent by the

volume of pig-iron production, about five per cent by the price of wheat, and about four per cent by the size of the corn crop two years previous. It is obvious that there is considerable sympathy between corn and wheat prices, because of the fact that the two grains have somewhat similar food value and can be substituted to some extent for each other with a fair degree of satisfaction. Other things being equal, it seems that there is a tendency when wheat prices are twenty per cent below normal for corn prices to be three or four per cent below normal, and vice versa. As the years go on, it seems that corn prices gain somewhat on wheat prices. At any rate, during the twenty years following the Civil War, corn sold, on the average, at only one half as much per bushel as wheat; whereas since 1890 corn has sold, on the average, at about two thirds as much per bushel as wheat; and in years of short corn crops and fairly good wheat crops, corn has often sold during the late summer for fully as much per bushel as wheat in Missouri, Kansas, and Nebraska. Corn has some industrial uses to which wheat is not adapted; and, moreover, the area of good corn land is much more fully occupied at the present time than the area of good wheat land. On this account there is a chance that corn values will gain on wheat values until corn is selling for almost as much per bushel as wheat, even in years when the crops of both are normal. The immediate prospect, however, is that corn will sell, one year with another, for about seventy per cent as much per bushel as wheat.

It is rather curious that the size of the corn crop two years previous should have an effect on corn prices this year. The logic of the situation is that a large crop and low prices, two years previous, encourages more breeding of brood sows; and the increased hog population which

thus results eats into the corn surplus, and has an effect on the corn market about two years later. This analysis is confirmed by another study which indicates that corn prices during the winter are likely to be three or four per cent higher than would be the case if the packers slaughtered about eight per cent more hogs than usual during the preceding summer. But while, occasionally, hog situations may have some influence on corn, it is more generally true that corn leads the way and hogs follow.

The corn-hog cycle may briefly be described as follows: To start with, we shall assume that the corn crop is small and corn prices are high, and that hog farmers find it difficult, therefore, to convert corn into hog flesh and make their customary manufacturing profit. They, therefore, reduce their breeding operations; and, after about eighteen months, a hog shortage and high hog prices result. Unless something unusual has happened to the corn crop, there is a tendency at this time for hogs to sell much higher relatively than corn. So the hog farmers now begin to breed more than their usual number of brood sows, with the result that, about eighteen months later, the situation is reversed again.

Over any period of ten years or more the relationship of corn and hog prices is quite a constant factor, as may be grasped from Table 36.

It will be noted that the ratio between Chicago corn and Chicago hogs has been remarkably constant from one decade to the next, although there is a seasonal swing which makes the normal ratio somewhat different for different months of the year. But while the ten-year averages are remarkably constant, it is found, on studying the actual corn and hog prices month by month, that there is great variation. The tendency is for hogs to sell

TABLE 36. CORN-HOG RATIOS, 1870–1919

MONTHS	1870–79	1880–89	1890–99	1900–09	1910–19	FIFTY-YEAR AVERAGE
January	11.9	11.7	12.3	11.8	11.4	11.8
February	12.6	12.6	12.6	12.2	12.0	12.4
March	12.3	12.4	12.3	12.2	12.4	12.3
April	11.5	11.9	11.8	12.1	11.9	11.8
May	10.3	11.3	10.8	11.0	11.4	10.9
June	10.1	11.3	11.2	11.1	11.0	10.9
July	10.7	11.7	11.4	11.0	10.4	11.0
August	11.4	11.4	10.9	10.7	10.3	10.9
September	11.8	11.1	11.6	11.1	11.1	11.3
October	11.3	11.0	11.6	11.0	11.0	11.2
November	10.6	10.2	10.5	10.5	10.6	10.5
December	10.9	10.9	11.2	10.9	10.5	10.9

about eighteen months above their normal ratio with corn, and then about eighteen months below.

The three factors which tend somewhat to modify this periodicity are: first, unusual outbreaks of hog cholera which may cause a hog shortage at a time when it would otherwise not be expected; second, business prosperity or depression causing variation in the demand for pork; and, third, unusually plentiful and low-priced corn or unusually scarce and high-priced corn. The cholera factor, previous to the general use of vaccination, occasionally modified the corn-hog cycle materially. It is doubtful, however, if it will have so much influence henceforth. The business cycle will always doubtless have a profound influence on the corn-hog cycle. At any rate, a graph of the corn-hog cycle indicates that it has many astonishing points of resemblance to graphs of the business cycle. Hogs were below their normal ratio with corn prices at the same time that business was depressed in 1902 and 1903; and they went above their normal ratio with corn prices at the same time that business expanded in 1905

and 1906. Hogs and business went down together in late 1907 and rose almost together in 1909 and 1910.

In an effort to obtain an empirical formula for predicting hog prices, a study has been made of the forty-year period preceding the War. Winter hog costs per hundred

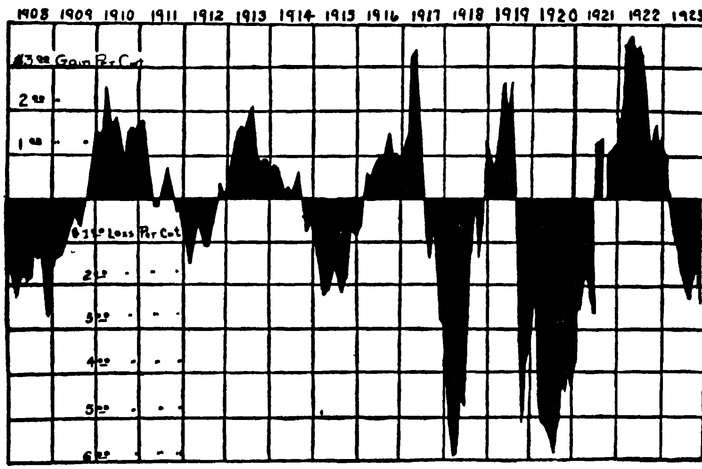


FIGURE 49. VARIATIONS OF CHICAGO HOG PRICES FROM THEIR NORMAL RATIO WITH CHICAGO CORN PRICES

pounds to western packers have been used as the dependent variable. The object has been to discover independent variables which apparently were acting some time in advance to cause changes in the winter price of hogs. Every variable used was put into the form of plus or minus deviations from the secular trend; and in every case the secular trend was obtained by fitting one straight line to the data from 1876 to 1900, and another straight line from 1891 to 1915, and then compromising the overlapping period in the nineties by a system of weighting so that the transition from the one straight line to the other might be made as gradual as possible. With the limited

time available, it seemed to be advisable to use this plan of two straight lines rather than to use a curved line for expressing the secular trend. And there may possibly be some scientific justification for using two straight lines for expressing secular trend rather than a curved line, when working with data such as that characterizing the period from 1876 to 1915.

The winter hog price deviations from the secular trend were correlated with various measures of business activity in an effort to get some barometer of consuming demand. Volume of transactions on the New York Stock Exchange correlated .27. Net railroad earnings per mile correlated .4151, and the volume of New York bank clearings correlated .4933. Pig-iron production (deviations in this case on account of the unusual growth factor were from a logarithmic curve) correlated .2566. Of all the series available during the forty years preceding the War, New York bank clearings seemed to be the best measure of the demand for hog products. The New York bank clearings were for the calendar year in each case, and the hog prices were the average of November and December of that year and January and February of the year following. It may be seen therefore that the way in which the data are used roughly assumes that hog prices lag about six months behind New York bank clearings.

One of the best ways of measuring the future supply of hogs a year or so in advance, is by means of the corn-hog ratio. It has been found in this study that winter hog prices correlate with the ratio between Illinois December farm corn prices two years previous and the winter hog prices also two years previous, to the extent of a negative correlation of .5030. A variable which expresses both supply and demand and which is a projection of the past into the immediate future, is the price of hogs during the

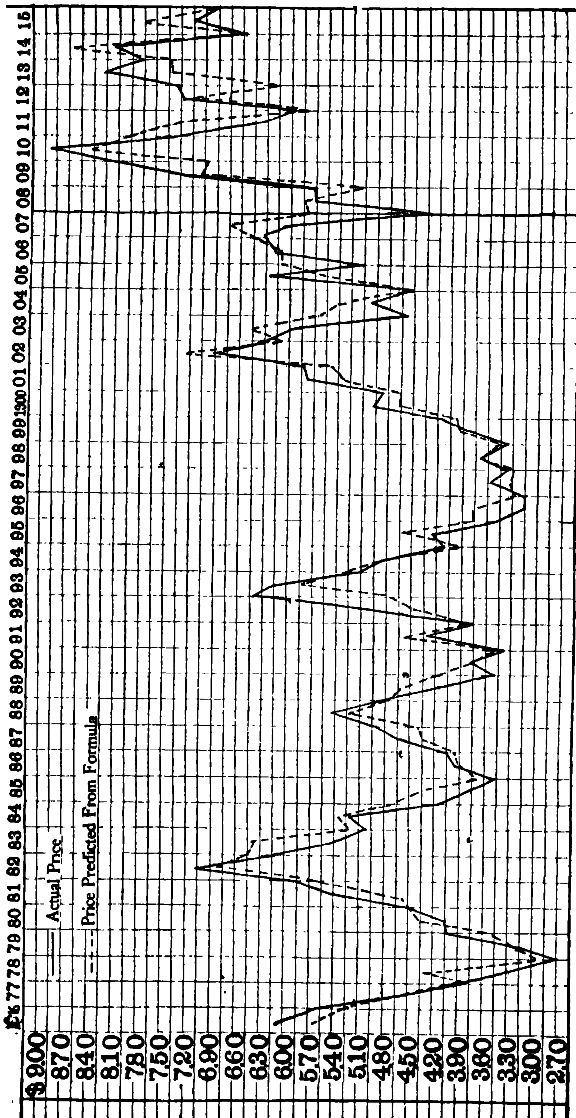


FIGURE 50. HOG PRICES: ACTUAL PRICES COMPARED WITH PRICES PREDICTED FROM FORMULA

summer immediately preceding. The correlation here is .7776. This is doubtless higher than would be expected theoretically because of the fact that, under the mathematical method used, the hog prices immediately preceding also help to correct for the general price level.

After the inter-correlations between these various factors were obtained, the multiple regression line or predicting formula was worked out. The answer was .67 of the percentage deviation of the summer hog prices from their secular trend, plus .21 of the percentage deviation of New York bank clearings from their secular trend, minus 1.2 times the number of bushels winter hog prices two years previous represented more or less than their normal in terms of Illinois farm December corn prices, equals the percentage the winter hog prices deviate from their secular trend.[1]

To illustrate the formula in terms of the present situation: First, the price of hogs in the summer of 1923 averaged $7.50. If we assume that hog prices in the summer of 1923 should have been as far above their 1904–13 average as were farm products generally, as reported by the Bureau of Labor Statistics, we get a secular trend price of $10.32. It would seem, therefore, that hog prices were twenty-seven per cent below their secular trend. Using our formula we should expect, because of this, that hog prices this winter would tend to be about eighteen per cent below their secular trend. If we assume that New York bank clearings for 1923 were ten per cent

[1] The equation is: $.67a + .21b - 1.2c = x$; where a represents percentage deviation of hog prices at Western markets the previous summer from their secular trend; b represents percentage deviation of New York bank clearings for the calendar year just previous; c represents the number of bushels the ratio between Illinois December corn and winter hog prices was above or below the fifty-year average ratio two years previous; x equals percentage the winter hog prices at Western markets deviate from their secular trend.

above their secular trend, we should expect on that account that hog prices this winter would be two per cent above their secular trend. The ratio between Illinois farm corn prices in December of 1921 and the winter hog prices at that time, was 20.8 bushels, or 6.9 bushels above the fifty-year average relationship. Using our formula, we should expect, because of this unusually favorable relationship two years ago, that hogs this winter would be selling eight per cent below their secular trend. Adding the − 18, the + 2, and the − 8, we get a total of − 24 per cent. If we obtain the secular trend price of hogs for this winter in the same way as we did the secular trend price of summer hogs, we get $9.64. Taking twenty-four per cent away from the $9.64, we have left $7.33 as the predicted price of hogs at Western packing points this winter, as an average of November and December of 1923 and January and February of 1924. During the forty years preceding the War, the predicting formula as here given had a multiple coefficient of correlation of .83.

Using a similar method for predicting summer hog prices, a multiple regression line has been obtained which gives results correlating with the actual to the extent of .898. In this case the factors used are winter hog prices just preceding, New York bank clearings the year previous, and Illinois corn prices the year previous. These factors can be ascertained with a fair degree of accuracy several months in advance. When the predictions of the forecasting formula are graphed on the same sheet of paper with the actual prices, it is found that on the whole the agreement is very close, and that the discrepancies are usually a result of the actual price reversing its direction more suddenly than the predicted. For example, if hog prices have been unusually low for a time, the reversal comes with greater suddenness and moves to a

greater extent than would be expected from any method of prediction.

It ought to be possible to improve a predicting formula of this sort considerably. We undoubtedly now have better measures of the future demand than New York bank clearings. It is also possible now to predict the future supply of hogs much more accurately since the inauguration of the semi-annual census of the hog population by the Department of Agriculture and the Post Office Department. Some of the discrepancies between the predicted price and the actual price are due to the fact that the predicting formula cannot take into account any sudden shortage resulting from hog disease. This probably accounts for the discrepancy in late 1912 and the summer of 1913. No matter what predicting formula may be used, it must always be employed with intelligence. There are always things which are not taken into account in the formula. A formula of this sort, in fact, is of value chiefly as giving a point of departure.

CHAPTER XVIII

AGRICULTURAL AND BUSINESS CYCLES

By G. F. WARREN and F. A. PEARSON

With changes in industrial conditions, the demands for different classes of farm products change strikingly. When there is full employment at high wages, the choicer kinds of food are in great demand, as are other things that are desired in amounts beyond the usual capacity to buy. When, as in 1923, and as in the period following the Civil War, there is full employment at high wages, at the same time that food is very cheap, the changes are extremely violent. In October, 1923, wages were double pre-War wages and there was full employment. Food at retail averaged only fifty-five per cent above the five-year pre-War price, while the average price paid to farmers for food was only twenty-three per cent above the pre-War prices. Such a violent maladjustment probably never would occur except as a result of a period of rapid inflation followed by rapid deflation. The same principle is, however, illustrated during every business cycle.

When food is very cheap and there is full employment, there is a great demand for clothing, and both cotton and wool in 1923 were exceedingly high in price. The consumption of cotton in Europe was about two thirds of the pre-War rate, but the American consumption was very high and the farm price in October was one hundred and thirty-eight per cent above the pre-War price. At the same time, the farm prices of foods averaged only twenty-three per cent above pre-War prices. Different classes of foods were very differently affected. Eggs and butter

were in demand. The better grades of each sort of food were much more in demand than were the poorer grades. Lamb was high in price compared with mutton. Near-by hennery white eggs were high in price compared with poorer grades of eggs. The Institute of American Meat Packers reported that in September, 1923, wholesale prices of pork loins in Chicago were sixty per cent above, but sides were twenty per cent below, pre-War prices. Carcass beef from prime native steers was thirty-five per cent above, that from medium steers thirteen per cent above, and that from cows ten per cent below, pre-War prices.[1] Since wages may be expected to be high for some years, as they were following the Civil War, the spread between prices of high and low grades of food may be expected to continue, except during periods of unemployment.

One of the factors in the cost of living, which is extremely elastic and which responds strikingly to a change in the purchasing power of wages in terms of food, is the number of rooms desired per capita. The present building boom is based on:

(1) Neglect of repairs to buildings and railroads during the War.
(2) A shortage of houses due to failure to build during the period when food was high, relative to wages.
(3) Great expansion in the desire for room because food is very cheap.
(4) Movement from farms to cities because the farmer gets so little for food and because wages in cities are so high.

Only the first two are on a sound basis. For a stable

[1] Charles E. Herrick, *Annual Address of the President*, Institute of American Meat Packers, p. 23 (1923).

condition, some of the effort now expended in city construction should be expended in improving farms, laying tile drains, repairing barns, fences and the like. While the city building boom lasts, farm repairs will be neglected.

The demand for house room is very elastic. Before many years, a reaction is likely to come. When it comes, and there is unemployment in cities, the population will suddenly find that much less room is necessary. Thrifty persons who have bought homes with a small cash payment are likely to find their equities wiped out; just as thrifty young farmers found their savings gone when farm values were readjusted. In any violent period of downward readjustment, there is a time when prices go far too low. City houses have a very real and permanent value; but there may be periods when these values cannot be converted into cash at anywhere near their true worth, just as it is now impossible to convert farmhouses, barns, and tile-drains into cash at their true worth. Banks are more involved in the financing of city real estate than they are in financing farms. The severest test of banks is likely to come when city real estate values are readjusted. Correlations of lumber prices with industrial conditions, or with a combination of food prices and wage rates, would be interesting; but these correlations have not yet been completed.

Before comparing agriculture and industry, we must have a yardstick for each industry. A number of measures of business conditions have been used, such as prices of twelve industrial stocks, interest rates on four to six months commercial paper, dividend payments, production of pig-iron, unfilled orders of the United States Steel Corporation, the Harvard commodity price index of business cycles, Bradstreet's index number, and an index of industrial conditions that combines prices of stocks, Har-

vard index with a lag of six months, pig-iron production with a lag of three months, and interest rates with a lag of eight months.

For each series for both agriculture and industry, the secular trends and seasonal variations were calculated. For stocks, the cycles were calculated with and without seasonal variation. The seasonal variation was so small that, in the later work, it was ignored. Several base periods were used; but the ones now used are the seventeen years of declining prices ending with 1896, and the seventeen years of rising prices from 1897 to 1913, inclusive. Full details of the methods used will be given in a forthcoming publication. The methods for computing cycles are like the ones used in the Harvard publications, except that seasonal variation is now calculated by averaging the data for each month and making corrections according to the secular trends; that is, if the trend is up, the trend for half a month is subtracted from July, one and one half from August, one half month is added to June, etc.

Coefficients of correlation were calculated for each pair of cycles, with various lags, in order to find the lag with the closest correlation. Coefficients of correlation for the basic industrial measures, for the lags with highest correlations, are shown in Table 37. One of the comparisons to determine the best lag is shown in Table 38.

Of the various measures of business conditions thus far used, the price of industrial stocks and the Harvard commodity price index show the highest correlation with prices of farm products. Since the price of stocks is, on the average, about six months quicker in showing trends than the Harvard index, it is now used for most of the comparisons. For those prices that respond slowly to industrial conditions, such as cotton, milk, and starch crops, the Harvard index may also be used for forecast-

TABLE 37. COEFFICIENTS OF CORRELATION FOR MONTHS OF HIGHEST CORRELATION FOR PRICE CYCLES, 1897–1913

	Industrial Stocks		Harvard Index		Bradstreet's		Interest Rates		Production of Pig-Iron	
	Months preceding	Correlation	Months preceding	Correlation	Months preceding	Correlation	Months preceding	Correlation	Months preceding	Correlation
Industrial stocks	..	.	−6 to −9	0 69	−6 to −8	0 65	−8	0 55	−3	0.66
Harvard index	6 to 9	0 69	..		0	0 84	−3	0 66	1	0.64
Bradstreet's	7 to 8	0.65	0	0 84	..	..	..	..	..	..
Interest rates	8	0.55	3	0 66	..	..	..	..	5	0.71
Production of pig-iron	3	0.66	−1	0 64	..	..	−5	0.71	..	..
Farm price milk, Utica, N.Y.	15	0.43	10	0 47	7	0 27	8 to 9	0.23	12	0.24
Chicago shippers' price, milk	15	0.41	6	0 37[a]	..	..	..	..	..	..
Milk, N.Y., Phila., Chicago, St. Louis	14	0 56	8	0 58	6	0.48[b]	5	0.43	10	0.33
Butter, N.Y.	9 to 10	0.31	0	0 37[a]	..	..	..	..	..	..
Cheese, N.Y.	8 to 9	0 55	0	0 47[a]	..	..	..	..	..	..
Heavy hogs, Chicago	6	0 39	0	0 52[b]	..	..	−1	0.28	..	..
Dun's meat index	11	0 37	0	0.41[a]	..	..	..	..	..	..
Corn, oats, wheat, potatoes	30	0 75	..	..	..	..	..	..	..	..
Cotton, N.Y.	13	0 45	6	0 60[a]	..	..	..	..	..	..

[a] Correlations calculated for zero, 6, 12 months only.

[b] Only one calculation made.

TABLE 38. COEFFICIENTS OF CORRELATION OF PRICE CYCLES FOR TWELVE INDUSTRIAL STOCKS, AND FOR THE PRICE PAID TO PRODUCERS FOR MILK AT UTICA, N.Y., PHILADELPHIA, CHICAGO, AND ST. LOUIS, WITH VARIOUS MONTHS OF LAG, 1897–1913

Months by which Milk Prices Lag	Correlation	
0	−0 25	±0 04
1	−0 21	±0.05
2	−0 16	±0 05
3	−0 09	±0 05
4	−0 04	±0 05
5	0 05	±0 05
6	0 11	±0 05
7	0 20	±0 05
8	0 28	±0.04
9	0 35	±0 04
10	0 41	±0 04
11	0 45	±0 04
12	0 50	±0 04
13	0 53	±0 04
14	0 56	±0 03
15	0 55	±0 03
16	0 52	±0 04
17	0 51	±0 04
18	0 50	±0 04
19	0 47	±0 04
20	0 46	±0 04
21	0 48	±0 04

ing. The combination of stocks, interest rates, pig-iron production and the Harvard index shows a high correlation with other data; but this is open to the objection that it is not so prompt an indicator as the stock market. The Harvard index is a very good barometer of business conditions. It fluctuates about three times as violently as does the United States Bureau of Labor index number for all commodities. In the period 1890–1914, the rise and fall with the Harvard cycle averaged nineteen months and the average amount of rise and fall was twenty-nine per cent. Before the War, the average for the United States Bureau of Labor index was ten per cent.

An index of the total wage payments would doubtless show very high correlations with prices of various grades and classes of farm products. For forecasting, this would doubtless be slow.

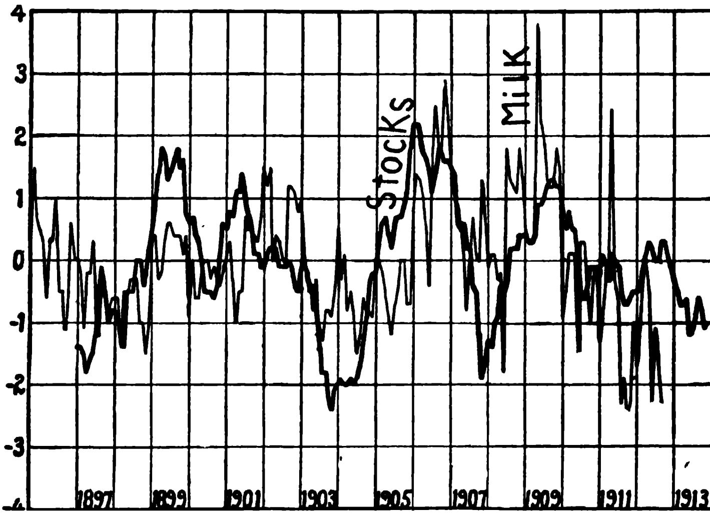


FIGURE 51. PRICE CYCLES FOR INDUSTRIAL STOCKS AND FOR PRICES PAID TO FARMERS FOR MILK AT UTICA, NEW YORK, FIFTEEN MONTHS LATER

(Coefficient of correlation 0.43 The dates at the bottom of the figure refer to stock prices. The units in Figures 51–55 are standard deviations.)

The Harvard index shows the highest correlation (0.69) when compared with the stock cycle six to nine months previous. (See Table 39.) The cycle for the price of cotton is most highly correlated with the stock cycle when cotton is given a lag of thirteen months. For most of the relationships, many correlations were made to find the relationships with various lags. For example, the price paid for milk to producers for four cities shows a negative correlation of 0.25, when directly compared with the stock cycle. But fourteen months later the milk

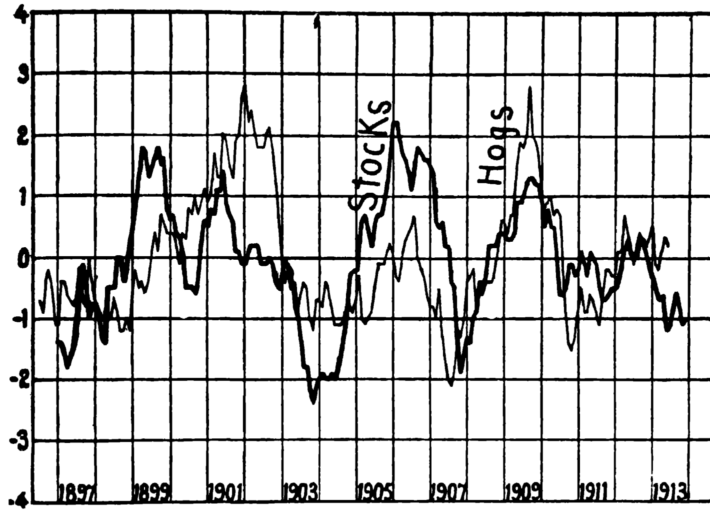


FIGURE 52. PRICE CYCLES FOR INDUSTRIAL STOCKS AND FOR HEAVY HOGS AT CHICAGO SIX MONTHS LATER

(Coefficient of correlation 0.39. The dates at the bottom of the figure refer to stock prices.)

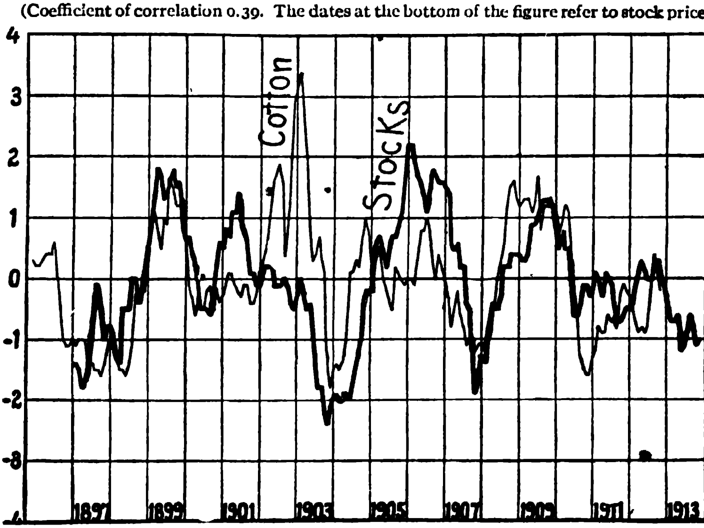


FIGURE 53. PRICE CYCLES FOR INDUSTRIAL STOCKS AND FOR MIDDLING UPLAND COTTON AT NEW YORK THIRTEEN MONTHS LATER

(Coefficient of correlation 0.45. The dates at the bottom of the figure refer to stock prices.)

TABLE 39. PRICES OF TWELVE INDUSTRIAL STOCKS CORRELATED WITH OTHER FACTORS, 1897–1913

	Months Later	Correlation	
Harvard commodity price index of business cycles	6 to 9	0.69	±0.03
Bradstreet's index number	7 to 8	0.65	±0.03
Interest rates on 4 to 6 months commercial paper	0	0.05	±0.05
Interest rates on 4 to 6 months commercial paper	8	0 55	±0.03
Production of pig-iron	3	0 66	±0.03
Milk, farm price at Utica, N.Y.	0	−0.24	±0.05
Milk, farm price at Utica, N.Y.	15	0.43	±0.04
Milk, price paid to producers at Chicago	0	−0.22	±0.05
Milk, price paid to producers at Chicago	15	0.41	±0.04
Milk, New York, Philadelphia, Chicago, St. Louis	0	−0.25	±0.04
Milk, New York, Philadelphia, Chicago, St. Louis	14	0.56	±0.03
Butter, First to creamery extra, New York	0	0.21	±0.05
Butter, First to creamery extra, New York	9 to 10	0.31	±0.04
Cheese, Good to fancy, New York	0	0.24	±0.05
Cheese, Good to fancy, New York	8 to 9	0.55	±0.03
Heavy hogs, Chicago	0	0 21	±0.05
Heavy hogs, Chicago	6	0.39	±0.04
Mess pork, New York	0	0.15	±0.05
Mess pork, New York	10	0.42	±0.04
Dun's meat index	0	−0.22	±0.05
Dun's meat index	11	0.37	±0.04
Cotton, Middling Upland, New York	0	−0.24	±0.04
Cotton, Middling Upland, New York	13	0.45	±0.04
Packer hides, heavy mature steers, Chicago	0	0.64	±0.03
Cotton, Dun's meat, milk, 4 cities	0	−0.24	
Cotton, Dun's meat, milk, 4 cities	13	0.64	
4 Starch crops — corn, oats, wheat, potatoes	0	−0.19	
4 Starch crops — corn, oats, wheat, potatoes	30	0.75	±0.02

price tends to follow the price of stocks, as is indicated by a correlation of 0.56. (See Table 40.)

The data seem to indicate that the stock market is the promptest indicator of probable demand for farm products. Some products, like hides, respond as promptly as does the stock market. In about six to nine months after the stock market rises or falls, the demand for pork, butter, and cheese responds. For products like milk and cotton, the demand follows much more slowly, and it is over a year before the greatest relationship occurs. Apparently, the price of starch crops follows industrial conditions with a lag of over two years. Coincident, there is

TABLE 40. DAIRY PRODUCTS CORRELATED WITH OTHER FACTORS, 1897–1913

	Months Earlier	Correlation	
Milk shippers' prices, New York, Philadelphia, Chicago, St. Louis correlated with:			
12 industrial stocks	0	−0.25	±0.04
12 industrial stocks	14	0.56	±0.03
Bradstreet's index number	6	0.48	±0.04
Interest rates, 4 to 6 months commercial paper	5	0.43	±0.04
Monthly tonnage of pig-iron production	0	−0.26	±0.04
Monthly tonnage of pig-iron production	10	0.33	±0.04
Harvard commodity price business cycles	7 to 8	0.58	±0.03
First to extra creamery butter, New York	0	0.22	±0.05
First to extra creamery butter, New York	12	0.39	±0.04
Good to fancy cheese, New York	0	0.20	±0.05
Good to fancy cheese, New York	8 to 11	0.27	±0.05
Heavy hogs, Chicago	9 to 10	0.51	±0.04
Mess pork, New York	7 to 8	0.50	±0.04
Middling Upland Cotton, New York	3	0.28	±0.04
Cost of producing milk in New York	0	0.46	±0.04
Milk shippers' price, Chicago, correlated with:			
Farm price of milk, Utica, N.Y.	0	0.34	±0.04
First to fancy creamery butter, New York	0	0.11	±0.05
First to fancy creamery butter, New York	12	0.41	±0.04
Heavy hogs at Chicago	10	0.36	±0.04
Condensary milk in Illinois correlated with:			
Heavy hogs at Chicago	12	0.48	±0.04
Prices paid to producers for milk testing 3.7 per cent, Utica, N.Y., correlated with:			
12 industrial stocks	0	−0.24	±0.05
12 industrial stocks	15	0.43	±0.04
Harvard price index	0	0.06	±0.05
Harvard price index	10 to 11	0.47	±0.04
Interest rates	8 to 9	0.23	±0.05
Production of pig-iron	12	0.24	±0.05
Bradstreet's index number	7	0.27	±0.05
Middling Upland Cotton, New York	0	0.39	±0.04
First to extra creamery butter, New York	0	0.05	±0.05
First to extra creamery butter, New York	12	0.30	±0.04
Good to fancy cheese, New York	0	0.11	±0.05
Good to fancy cheese, New York	6 to 7	0.22	±0.05
Cost of production in New York	0	0.35	±0.04
Cost of production in New York and (6 months moving average prices)	3	0.42	±0.04
Price paid to shippers, Chicago	0	0.34	±0.04
Price paid to shippers, St. Louis	0	0.16	±0.05

TABLE 40. DAIRY PRODUCTS CORRELATED WITH OTHER FACTORS, 1897–1913. (*Continued*).

	MONTHS EARLIER	CORRELATION	
Price paid to shippers, Philadelphia	0	0.22	±0.05
Wholesale price milk, Montreal	0	0.18	±0.05
Receipts of cream and condensed milk in New York	0	−0.18	±0.05
Heavy hogs, Chicago	0	0.07	±0.05
Heavy hogs, Chicago	9	0.37	±0.04
Mess pork, New York	0	0.20	±0.05
Mess pork, New York	10	0.42	±0.04
Dun's meat index	0	−0.12	±0.05
Dun's meat index	10	0.22	±0.05
Butter, First to extra creamery, New York, correlated with:			
Milk, St. Louis	0	0.07	±0.05
Milk, St. Louis	12 (later)	0.26	±0.05
Heavy hogs, Chicago	0	0.32	±0.04
Cotton, Middling Upland, New York	0	−0.20	±0.05
Cheese, Good to fancy, New York, correlated with:			
Cotton, Middling Upland, New York	0	0.06	±0.05
Cotton, Middling Upland, New York	6 (later)	0.39	±0.04
Heavy hogs, Chicago	0	0.26	±0.04

No very significant correlations were found between stocks and prices of western fresh gathered first eggs, mess beef, or live chickens in car lots. There may be high correlations with other grades of these products.

a negative correlation of 0.19; but, thirty months later, there is a positive correlation of 0.75. Presumably the reason is that good industrial conditions cause consumers to demand more animal foods. This depresses the price of starch foods and raises the price of animal foods. As a result, the production of animals is increased. A considerable increase in animals then occurs at about the time when industrial expansion is checked; so that the demand for starch foods is high, both as food for animals and as food for people. At the same time, some reduction may also have occurred in the production of starch foods as a result of the low prices. The demand as feed for animals, however, is probably more important than the other

factors. From 1880 to 1896, inclusive, there also was considerable correlation between the prices of starch crops and industrial stocks, but the lag was much shorter. The correlation with no lag was +0.36, with a lag of eight to eleven months, +0.57. The writers have as yet no explanation for the striking change in lag. The correlation for the seventeen years ending with 1913 is so high as to

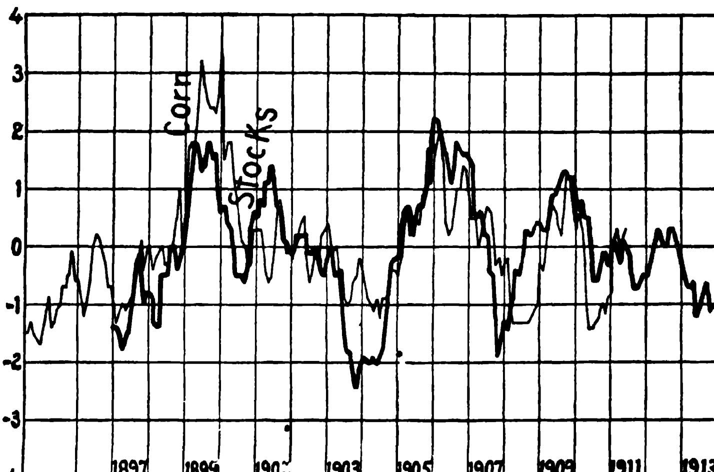


FIGURE 54. PRICE CYCLES FOR INDUSTRIAL STOCKS AND FOR CONTRACT GRADE OF CASH CORN AT CHICAGO THIRTY MONTHS LATER

(Coefficient of correlation 0.68. The dates at the bottom of the figure refer to stock prices.)

be almost unbelievable, but it does not seem possible that it can be due to accident. The three cycles for cotton, Dun's meat index, and milk for four cities were averaged to get a meat-clothing cycle. This cycle was correlated with the price of industrial stocks from 1897 to 1913, inclusive. With no lag, the correlation was −0.24. For a lag of thirteen months, the correlation was +0.64. (See Table 39.)

Most of the data so far presented deal with the demand

side of the equation. Production must also be considered before definite price forecasting is possible. A high supply may be accompanied by a low or a high demand. At the time when starch crops may be expected to be high, the crop yields may be high or low, so that they may raise the prices still higher or may check the rise.

In 1923, there was an excessive over-production of hogs and an excessive American demand for pork. The demand was not enough to make prices high in the face of a short European demand and a high supply. The complete cycle of over- and under-production for hogs is about five years. Hog prices are highly correlated with industrial conditions. Since the cycle is so nearly of the same length as the business cycle, the two often go together; so there is likely to be over-production of hogs at the time of low demand. For the period, 1897–1913, inclusive, prices of heavy hogs at Chicago with a lag of six months showed a correlation of +0.39 with the prices of industrial stocks. With a lag of thirty months, hog prices were correlated with hog prices and gave −0.28. While the cycles of high and low prices of hogs are striking, they vary in length; so it is possible that, with a given lag, the time might come when the cycle would be reversed. A correlation was made of hog prices with hog prices, when each half cycle was fitted to the preceding half cycle. This gave a correlation of −0.52. This indicates the degree of similarity of the price curves when not disturbed by variable lengths of lags. It shows the degree of reaction but does not tell the date when reaction occurs.[1]

For farm products, like beef cattle and horses, that have long cycles of over- or under-production, due to the years required in production, the business cycle may go up and down several times before the main cattle or horse

[1] See Chapter XVI, above.

cycles change. The demand cycle is then superimposed on the production cycle. For beef cattle, the full cycle of prices lasts about fourteen years. The business cycle has considerable influence. For horses, the full cycle of prices lasts about twenty years; and it is so dominating that such influences as industrial conditions are largely obscured. For example, the horse cycle is so dominating that the price of horses has dropped almost continuously since before the War.

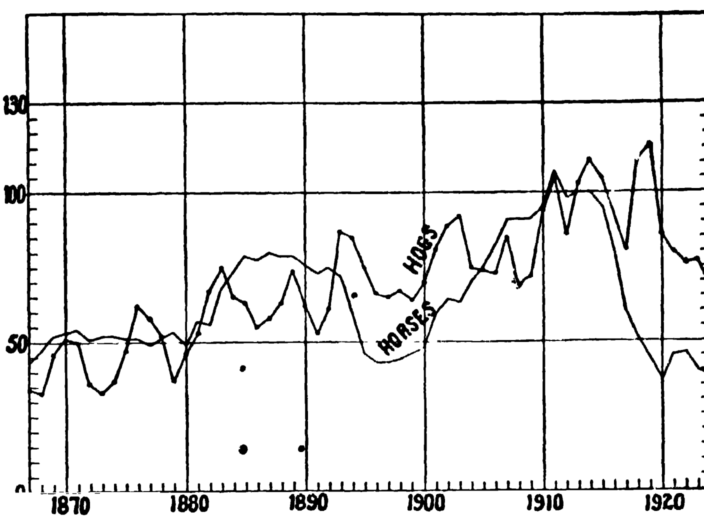


FIGURE 55. PURCHASING POWER OF HOGS AND HORSES. 1910–14=100
(The hog cycle is usually about the same length as the business cycle. Cycles for high and low prices for horses are about twenty-five years long.)

Some of the major forces that control the prices of farm products seem to be:

(1) Industrial conditions acting on demand.
(2) Cycles of high and low production due to efforts to increase or reduce production.

(3) High or low yield of crops per acre due primarily to the weather.
(4) Other factors such as hog cholera. Most of these other factors are non-cyclical.

Apparently, the business cycle has a striking influence, both direct and indirect, on prices of farm products. An expansion of business conditions seems to be followed by a striking increase in the demand for clothing, housing, and for those foods which are ordinarily consumed in a much smaller quantity than appetite desires; such as meat, milk, butter and cheese. The demand also shifts from the poorer to the higher grades.

Starch crops are in demand both for animal and for human food. The human demand for these crops is less flexible than the demand for meat; but it does vary, and in the opposite direction from the demand for meat. The demand for starch crops for feed for live stock is highly flexible, and lags behind the human demand for meat. Following the business cycle, it appears that the human demand for starch crops is likely to be high at the same time that the demand as food for animals is high. The prices of cotton, meats, and the like seem to follow the prices of industrial stocks with a lag of about a year. Prices of starch crops are likely to lag a little more than two years.

It is believed that by combining the business cycle with the cycles of over- and under-production, and, in the case of crops, including the influence of weather, prices of farm products may be forecast with sufficient accuracy to be of service. Apparently, the amount of the price change may be forecast with greater accuracy than the date of the change. When the currency is unstable, correction must be made for this factor.

CHAPTER XIX

FORECASTING CROPS FROM WEATHER CONDITIONS

By J. B. KINCER

Two main lines of research, dealing with the relation of weather to crops, have been and are now being followed by investigators in several different countries. The first of these involves an effort to establish meteorological cycles, or quasi-regular sequences, comprising a definite number of years, the recurring phases of which will show meteorological conditions quite similar to their predecessors, with a consequent reproduction of agricultural phenomena. The second method has to do with the influence of weather on crop development during, or shortly before, the growth period, and is usually studied by a statistical determination of the relation between the weather and yield. The ultimate goal of all such investigations is to forecast crop yields in advance of harvest.

It will be seen that the first method has to do with long-range forecasting; that is, a determination, several years in advance, of the kind of weather and hence yield that may be expected in a particular season. Clearly, the establishment of cycles or periods of this character, whereby an indication could be given of probable yield far in advance, even within rather wide limits of accuracy, either in a given area or for the world at large, would be an achievement of the very highest importance. Professor H. L. Moore, of Columbia University, perhaps the leading exponent of such studies, has recently published two books, in which he has endeavored to show that crop

production and prices and prices of raw material and manufactured articles tend to vary with more or less dependable regularity in sequent periods of about eight years. Professor Moores' books are entitled: *Economic Cycles, Their Law and Cause,* and *Generating Economic Cycles,* the former published in 1914 and the latter in 1923.

Sir Napier Shaw, in 1906, found an apparent eleven-year cycle in wheat yields in England; and Sir William Beveridge, in 1920, published a paper in which an apparent cycle of sixteen years was found for wheat prices, which was inferentially related to production, although the latter was not meteorologically determined. It appears that the difficulty in the application of apparently significant results in these investigations to the probable course of events in future is found largely in the bewildering number of cycles actually or apparently determined.

The second method, which deals with the weather prevailing during plant development, has received attention from a much greater number of investigators, and is considered the more promising. The relation between weather and crop yield may be shown broadly by various graphical methods, but preferably they should be studied in the final analysis by statistical correlations. Very valuable pioneer as well as more recent work has been done in this field by Professor J. Warren Smith, who as early as 1903 published an article in the *Yearbook* of the United States Department of Agriculture, dealing with the relation of precipitation to the yield of corn, and since that time various papers on the relation of weather to crop yields have been published in this country by employees of the Weather Bureau, and others, including the results of a rather exhaustive study of weather and corn yield by H. A. Wallace published in the *Monthly Weather Review,*

August, 1920,[1] and a book by Professor H. L. Moore entitled *Forecasting the Yield and the Price of Cotton*, published in 1917.

In England, during the past quarter of a century, the relation between weather and crops has formed the subject of the inaugural address of two presidents of the Royal Meteorological Society, Mr. Mawley, in 1898, and Mr. Hooker, in 1921; while a number of papers have been published in recent years by other investigators, including Sir Napier Shaw and A. D. Hall. In other countries there may be mentioned Wallen, of Sweden; Okada, of Japan; Taylor, of Australia; and Jacob, of India. The last-named has successfully adopted the method of considering variations from empirically established optimum weather conditions in wheat production as employed by the writer, in 1915, in a correlation of weather and cotton in Texas. In recent years, the study has centered largely on the least-square correlation method applied to weather and yield data, and the use of the coefficient of correlation, as an expression of a measure of relationship, has become quite popular. Direct or simple correlation is usually employed for two variables, and partial or multiple correlation where more than two are involved.

It is not the purpose of this paper to present details of any specific investigation in the relation of weather to crop yield, nor to discuss the details of procedure in the statistical operations used in these investigations, but rather to consider, briefly, the problem from a broad viewpoint, and to point out and discuss those things which, in our opinion, present the more formidable difficulties in investigational work, together with suggestions as to possible remedies. These it is thought are especially appropriate at this time, because of the fact that all the

[1] See, also, Chapter XVI, above.

leading workers on the general structure, in independent investigations in different countries, seem to have builded to a rather uniform height, but just short of that point of perfection which the trained and exacting scientific mind considers to be sufficiently established to warrant presentation as a finished product, and one on which he would be willing to stake a reputation in the scientific world when his device is to be used as an instrument for definite forecasting purposes. It can be truthfully said that the science of Agricultural Meteorology is yet in its infancy and that wonderful advances have been made in the last decade. Within that period, studies of the relation of weather to crops have progressed to the point which inspires hope for still further advance in the near future. The meteorological requirements of most staple crops have been rather definitely established, and critical periods of growth determined during which the weather influence is most potent.

The first question that suggests itself is the adequacy of the correlation coefficient as an expression of relationship in studies of this kind. The correlation method reveals the frequency with which one set of data, showing facts in the nature of results, tends to be associated with another set of data, which may or may not be causative. It is obvious, then, that causation must be determined from such side evidence as can be adduced to explain the sequence. The significance of the correlation coefficient in straight-line relations depends upon its magnitude in relation to unity. Most investigators consider a coefficient of 0.40 as indicating a more or less definite relation; but, for forecasting purposes, one of less than 0.80, determined from a reasonably large number of observations with a corresponding small probable error, has a limited value. Several investigators have obtained coefficients of

0.80 or higher. The nature of the data to be correlated should always be carefully considered before accepting the results as indicative of relation. While a high coefficient, with a small probable error, always implies a connection, either direct or indirect, between two phenomena, the converse by no means holds.

The relation may not be a linear one; in fact, there is no *a priori* reason for believing that it is so in many cases. Evidently, after optimum values for plant requirements are reached in the several meteorological elements, additional moisture or warmth would cease to promote further favorable development; but an excess above the optimum may or may not be detrimental to yield. In either case, especially if the excess should be harmful, the straight line would be a bad representation and the ordinary coefficient of correlation very misleading. Some curve, a section of a parabola or perhaps a more complicated curve, would give better representation.

Attention is also invited to certain features in the correlation of monthly rainfall with crop production, as determined by the "least square" coefficient method. There is a tendency, very marked in some cases, for negative departures of rainfall to exceed the positive departures from normal; in other words, the mean and median sometimes have but little in common. In such case, the associated set of data, the yields, may have approximately as many positive as negative departures. A specific instance in the lack of uniformity in this connection may be cited in the case of July rainfall in Texas for the last thirty-two years. An examination of these data show that when the year-by-year departures from normal are computed for the entire period, we obtain ten positive and twenty-two negative values. Under such conditions, assuming that the yields show no such

variance in positive and negative departures, it is clear that if the normal rainfall be taken as a base, the correlation coefficient will necessarily be small, notwithstanding that a close relation may exist between the actual rainfall and yield. Here some other base, perhaps the median, should be used.

These facts warn us that, while we may accept a high correlation as significant, a smaller one should not be discarded until the nature of the data is subjected to further searching analysis and rigid examination. The first step in a study to determine a suspected relationship of two sets of variables should always be accomplished by charting the data on some form of coördinated graph, such as the familiar dot chart. The arrangement of the dots invariably gives a broad indication as to whether there is a relation, and also the general nature of the relationship when one is disclosed; that is, whether a straight line or some form of curve fits the data best.

One of the most useful purposes of the correlation method is found in determining critical periods of development by showing the relative importance of weather during short intervals of time in the life of the plant. This is a question of vital importance in investigational work; but it presents some difficulties in practice which can hardly be successfully met in an extensive way, with the observational data available. In some crops, at least, it has been shown that the critical period of growth is of comparatively short duration; but the question as to just how important this period is cannot be determined unless special observations of crop development are made, year by year, in conjunction with calendar time and weather conditions. This is true because of the fact that crops are not in the same stage of development during a given period of each year, for in some years a cool, backward

spring may retard advancement, while in others the early season may be such as to promote rapid development.

With the data available at present the best that can be done is to select that period which shows the highest correlation with yield as the most important, but without definite knowledge as to whether the status of plant development was the same in all the years comprising the series. For example; the period from July 15th to August 15th may show the highest correlation with yield in the case of corn; but, without a knowledge of the earliness and lateness of the crop in individual years comprising the series, this tells us only part of the story, and we could logically assume that this or some near-by similar interval would give much higher correlation, if we could fit the weather data to an interval of uniform state of development.

Only a few systematic, phenological records of development of staple crops, from year to year, and covering a considerable period of time are available for study. One of the most complete is that made by Mr. Thomas Mikesell, of Wauseon, Ohio. An examination of his records for a period of twenty-seven years shows that there were wide variations, amounting in one case to thirty-nine days, in the length of time required for corn to pass from the emergence to the roasting ear stage. Now, it is quite evident that if there be a critical period of, say, thirty days, or less, in any mathematical determination of the relation of weather to yield made by the use of these records, and in which the weather data refer to a definite calendar period of time for each year, the important period for many of the years would be only partially covered and for some, perhaps, missed entirely; consequently we should fall far short of the information sought. Moreover, it is obvious that a study of critical periods in

growth on the basis of actual plant development, as established by observations, rather than on a hit-or-miss plan of adopting a given number of days taken from the calendar, and so selected because that period showed the highest correlation, would give us much better results.

The question of rainfall intensity is also of much agricultural importance. It is customary for most investigators to consider the total amount of rainfall during the several divisions of the growing season, such as a combination of months, a single month, and frequently shorter intervals. It is obvious that rainfall of a given amount, say four inches, for a particular interval, could not under all circumstances have the same effect on growth; but rather its value would depend to a considerable extent on the intensity of the falls that go to make up the total, especially in regions where summer thundershowers are frequent. For example, the four inches may have fallen in one case in a couple of heavy downpours in which considerable quantities were lost by runoff, while in another the total may have been made up by rather frequent showers of moderate amounts.

The nearness to which the amount of moisture in the soil is maintained at an optimum for plant development is, of course, the basic criterion and the substitution of rainfall data for this undetermined soil moisture data, on the assumption that the moisture content must be directly in proportion to the amount of rainfall, could not hold when considerable amounts of the latter, by reason of excessive rate of fall, drain off without entering the soil at all.

A few investigators have endeavored to meet this situation by correcting the total rainfall on the basis of days with rain, or intensity of fall. Walter, of England, has made corrections on a basis of the ratio of rainy days to

total days in the period considered, while the writer has recently used the formula

$$R_n = \frac{R_n}{R + n}$$

where R_n represents the corrected rainfall data, R the total rainfall, and n the number of days on which rain fell. This feature deserves much more study than has been given to it. Closely allied thereto is the condition of the soil at the beginning of the period for which correlations are to be made. This is especially important when intervals of time are comparatively short. A deficiency of rain during an active growing month, when droughty conditions were prevailing at the beginning, would not have the same influence on the yield as if the soil were saturated at the beginning. In the latter instance the growing plants might actually suffer for moisture during a comparatively short time, while in the former, unfavorable conditions would be operative throughout. The shorter the period covered the more important it becomes that this feature be taken into account.

In these investigations it is customary first to determine, from correlation methods, the more important periods of growth in relation to the weather, and also the relative importance of the several meteorological factors, such as temperature, rainfall, and sunshine, for a long series of years. The several factors are then combined, through a system of regression equations, and the constant of relation applicable to each is evaluated mathematically, after which the theoretical yields may be computed by applying the constants thus obtained to the corresponding weather data. A comparison of these theoretical yields with the actual yields affords an indication of the value of weather data in forecasting, provided the

device used is inherently applicable to the test in hand and the data are adequate both as to accuracy and length of records. The significance of such results for future forecasting depends, of course, on the conformity of theoretically computed yields to actual yields and on the adequacy of the data entering into the equations.

When the second member of the equation contains several meteorological elements, or divisions of time, or both, an enormous amount of work is required to evaluate the several constants. Shorter methods may sometimes be used in such cases, particularly in preliminary work, which give very satisfactory results. Walter, in correlating the relation of weather to the yield of sugar, first computed the theoretical yields from the rainfall and then correlated the residuals (the differences between the theoretical yields, as computed, and the actual yields) with the temperature, assuming that these residuals represented largely the temperature influence.

Another method, which has been employed by the writer in a correlation of weather and corn in Ohio, consists of the determination of the coefficients of correlation for each of the variables or divisions of time to be used in the final equations, and then combining all the data into a single set of variables, after giving each datum its proper weight, as shown by the magnitude of the respective coefficient, the ratios for weighting to be in proportion to the squares of the coefficient. Thus with each set of data reduced to single values, the constants may readily be determined by the familiar equation $y = a + bx$, where y equals the yield, x the rainfall, and a and b are constants to be determined by solving two normal equations in the usual manner. Still another method which has been used consists in determining the weather influence, as reflected in the yield, and shown by correlation,

for each month of the growing season separately, and computing the theoretical condition of the crop at the end of the month. For the succeeding month, this condition is taken as a base and combined with the weather influence for that month, when a new theoretical condition is computed for the end of the second month, and so on up to maturity. The final theoretical condition is taken as an index of yield.

It should be strongly emphasized that the refined mathematical processes involved in these studies require for significant results that all the data used be highly dependable. So far as the weather data are concerned, the records are relatively of high accuracy, as to the observations themselves. There may be some question as to how applicable the available records are for correlation and coördination with crop condition and yield, but the errors arising from misapplication are relatively small. However, most of the yield data available are not the result of actual measurement, as in the other case, but represent largely estimates that often, inherently, fall short of these requirements. This is especially true by reason of the fact that yield data are required on a per acre basis, and this involves two possible sources of error when an estimated yield is accepted: that is, both the total yield and the actual acreage.

What about the future of agricultural meteorology? The number and variety of investigations dealing with the influence of weather on crops, which the method of correlation alone renders possible, is almost infinite, quite apart from the other processes at hand. It appears, therefore, that future progress depends largely on the securing of more complete observational data, whereby weather records may be synchronized with growth during known stages of plant development, and also whereby

accurate and dependable yield data may be had from actual measurement. It is uniformly conceded, by those most interested in the subject, that the greatest need of the present time is the collection of systematic meteorological data at representative experiment stations where test crops are grown under carefully observed conditions. The principal difficulty with observations carried on at experiment stations in the past has been found in the lack of technical experience, on the part of such workers, in systematically making homogeneous meteorological observations over a long period of years. It appears that suitable results can be obtained only when the meteorologist and the plant specialist work coöperatively. The fruits of such an effort will not, of course, become available until after the lapse of a good many years, but the matter is one that, unquestionably, deserves consideration at the present time, if the optimum of attainment in the future is to be reasonably expected.

Long ago the Weather Bureau recognized the importance of this matter in its investigational work. As early as 1914 a program was outlined looking to the establishment of several fully equipped meteorological stations, of the character indicated, in the more important agricultural sections of the country; but the exigencies arising from the War prevented the carrying out of the program. It appears now, however, that the time is appropriate for the matter again to be given careful consideration with a view to securing through Congressional action the relatively small appropriation required.

CHAPTER XX

FORECASTING CONDITIONS IN EUROPE

By JOSEPH STANCLIFFE DAVIS

The Point of View

The European situation may be examined from several standpoints. As doctors, we may diagnose, prescribe, and estimate chances of death, convalescence, relapse, or recovery. As lawyers advising clients in serious financial difficulties, we may investigate assets and claims, consider conditions essential to operating success, estimate future earnings, formulate schemes of reorganization, and seek to reconcile opposing interests to accepting sacrifices of legal rights. As preachers, we may convict of sin, warn sinners of dire consequences, point the path to righteousness, and adjure our reluctant hearers to follow the straight and narrow way. As political observers, we may discover and appraise hidden motives and invisible influences, trace out their ramifications, and forecast their net effects. As prophets, we may read the stars and signs and foretell improvement or disaster, catastrophe or millenium.

Each of these viewpoints has its virtues. All, and others I forbear to mention, may be necessary. Here, however, we attempt a different, if not a simpler task — to review and interpret the inadequate and conflicting evidence of economic progress and retrogression, to appraise the major forces at work, and to draw certain limited conclusions, warranted by the available facts. We approach the problem as economic interpreters, not even as economic advisers. We propose no solution of

Europe's problems. We attempt no economic astrology. We recognize the limitations of the data. We admit the incalculability of important political factors. But surveying the economic evidence, reasoning upon certain assumptions concerning imponderable elements, and relying upon the broad experience of the past, we seek to learn the direction of Europe's economic trends and the probable course of her economic development.

The Statistical Basis

At the outset it is necessary to say a few words concerning the statistical basis of the interpretation of Europe's position and outlook. In the first place, Europe is not an entity, but merely a geographical expression; and the European situation must be analyzed country by country. This is inevitable if a statistical basis is to be used, but there are additional reasons. The economic unity of the civilized world has been unduly stressed. The economic interdependence of nations is an important fact, but the degree of interdependence is smaller than many observers express or imply. Retrogression of some countries may occur while others are progressing. The swings of the business cycle are much larger in some countries than in others, and its peaks and troughs are by no means simultaneous throughout the world. The dependence upon certain basic industries — agriculture, iron and steel, shipbuilding, foreign trade, for example — varies greatly in different countries, and these variations have important consequences. For Europe as a whole, few generalizations can safely be drawn, and these, with their exceptions and qualifications, must grow out of detailed studies of individual countries.

In the second place, there is no possibility at present, and there is no early prospect, of employing a statistical

basis for forecasting business conditions in Europe, whether as a whole or in any single country, with anything approaching the modest success achieved in the study of American conditions. In general, the statistical material is quite inadequate and unsatisfactory. One essential is the availability of comparable data running back over a period of years before the War; but these are unobtainable in sufficient quantity, usually because they have not been compiled continuously, but in other cases because of boundary changes (for example, Germany, Austria-Hungary, Poland) or changes in bases of calculation (for example, French and Italian foreign trade). There are too few significant series expressed in physical units — carloadings, failures, tons produced. Too many series are distorted beyond possibility of correction by vacillations in the value of monetary units finding their direct expression in fluctuations of the price level and rates of foreign exchange. The problem of bias is especially important. For instance, when governments requisition food-stuffs, farmers are prone to conceal them, and material underestimates of crops become common; while different conditions lead to overestimates. When capacity to pay international indebtedness is in question, there is strong temptation for the debtor to suppress significant data of a favorable character and to emphasize data of unfavorable character, or *vice versa* if the creditor is investigating. Government statistics tend to be especially unreliable during years of political instability or in the hands of under-paid, inexperienced, and poorly led bureaucracies. Moreover, with the degradation of the academic and other salaried classes on the Continent, in consequence of currency depreciation, the intellectual resources for collecting and interpreting statistics are seriously diminished.

Some of these shortcomings only time will remedy. Some gaps will be filled as governments gain stability and experience, and as business men come to realize that their general interests warrant them in reporting, to central statistical agencies, data which individual concerns are reluctant to divulge. To a great extent the improvement in statistical data must await the passing of extreme instability of currencies and the relaxing of tension among the nations lately at war. The progress will be facilitated by the work of statisticians themselves. Every sound extension of the art of analyzing business conditions tends to bear fruit in new facilities for such research.

Recently there has been significant progress toward providing the requisite statistical basis for analyzing and forecasting business conditions abroad, and developing the art of analysis and interpretation. The International Institute of Agriculture continues its invaluable statistical work. The League of Nations not only publishes the Monthly Bulletin of Statistics, which assembles data already available, of increasing variety and scope; but the League Secretariat has made important comparative studies, more or less statistical in character, of various phases of economic and financial activity. The International Institute of Commerce at Brussels and the International Institute of Statistics at The Hague publish valuable and extensive compilations of data. The Dutch, French, and German Governments publish periodicals containing essential statistical data for these countries, and in some cases, comprehensive world surveys of particular industries. The Italian Government, and an association of Italian corporations, are publishing important statistical material. The Swedish Board of Trade has developed numerous indexes of Swedish economic conditions. Financial and commercial journals, like the Lon-

don *Economist* and the *Manchester Guardian Commercial*, are extending their statistical studies. Several banks, of which the Swiss Bank Corporation is a conspicuous example, are contributing valuable compilations, original series, and analyses. The London and Cambridge Economic Service has completed its first year of intensive study of current British economic conditions, supplemented by less intensive studies of conditions in Belgium, France, Germany, and Italy by correspondents in these countries.

In this country, several organizations are collecting and studying foreign data as well as American — the Federal Reserve Board, the Departments of Agriculture and Commerce, the Agricultural Exports Commission, and the Institute of Economics, to mention only a few examples. The foreign services of the Departments of Commerce and Agriculture have been greatly developed since the armistice, and are increasingly contributing data and analytical studies on European conditions. The Harvard Committee on Economic Research has made some valuable studies in British economic conditions, by methods developed in studying American conditions. Altogether, the amount of usable statistical material on economic conditions in Europe is greater than ever before; it is being assembled and studied, from many angles, with unprecedented assiduity; and the net result, deficient though it is, is far above contempt.

In default of a wholly satisfactory statistical basis, one can do much with the heterogeneous material now available, though with sparing use of refined statistical methods. The art of statistical interpretation, however, cannot be practiced *in vacuo*. Rather it requires the utmost perspective and the fullest recognition of facts that are immeasurable as such. The following discussion, there-

fore, while it rests largely upon statistical evidence which cannot be presented at length, necessarily takes account of evidence of a non-statistical character. It is particularly necessary to avoid undue reliance upon financial data which, though easily available, at best tell only part of the story and are especially influenced by currency conditions, speculative influences, and political changes.

The Background

The present situation in Europe can be understood only in the light of the past; and our appraisal of the outlook inevitably rests upon our interpretation of the past and the present. A review of the background is therefore prerequisite to a forward look. Here great diversity of views persists. Some paradoxically assert that European conditions have long been as bad as they could possibly be and have steadily grown worse. Others argue that Europe has made steady progress since the War, and only requires the recognition of Russia and a settlement of the reparations issue to regain quickly a normal equilibrium. Somewhere between these extremes lies the truth. My own conclusion is that much real, though irregular and disappointing, progress has been made, progress greater in fact than in appearance, but that normality is still far from attainment.

We must guard against too idealistic a conception of the European normal. Despite dreams of the good old days before the War, Europe has never been a paradise, or even a happy family thriving in concord. It has been a congeries of nations, each far from unified internally, extremely diverse in language, characteristics, ideals, ambitions, and interests, jealous and suspicious of one another, muddling along together after a fashion, but clashing frequently in war and in peace, with many a chip on shoul-

der and much powder and tinder waiting for a spark. Standards of living and of productivity, though varying greatly from country to country and from class to class, were by no means ideally high. These conditions remain, somewhat modified both favorably and unfavorably, but not fundamentally changed by the War and the Peace. Indefinitely they will handicap Europe's economic development as they always have. Much of the disappointment in Europe's recent progress is due to vain comparisons of the actual with the ideal.

Consider the matter of peace. There is small warrant for idealistic hopes that European wars are over for good and all. In Eastern, Central, Southeastern, Southern, and Western Europe the seeds of future wars are thickly sown, and some at least are germinating under conditions not unfavorable to growth. The old crops, however, have been grimly harvested; and without pretence to prediction, it seems reasonable to assume that time must elapse before new crops can mature. In Ireland, Upper Silesia, Central Europe, the Balkans, the Levant, and the Adriatic, troublesome situations have been smoothed out. In Western Europe the Ruhr campaign is closed. At no time since the Armistice has Europe been more nearly at peace than now. Moreover, the threat of revolution, of any but the bloodless type recently illustrated in Italy, Bulgaria, and Spain, seems substantially smaller than at any time in recent years.

The War wrought a profound maladjustment of Europe's resources; this was intensified by the feverish and ill-starred post-War boom. The direct devastation in Belgium, France, Italy, Serbia, Hungary, and Poland needs no emphasis. The indirect devastation, which equally calls for restoration, deserves equal attention. In Europe generally, livestock herds were seriously depleted

and impoverished in quality. Among the continental belligerents, agricultural productivity was seriously impaired. Railways and their equipment deteriorated where they were not destroyed. Maintenance, renewal, and replacement of buildings were neglected while new construction was largely postponed. The chief belligerents suffered irreparable losses of man power, which were especially serious for France. Europe's immaterial capital — her stable and integrated monetary systems, her vast network of established business relations and connections, her international understandings upon trade, transport, and taxation, imperfect though they were — these invisible resources were profoundly diminished. Fiscal policies were thrown out of joint and state treasuries faced with well-nigh insoluble problems.

On the other hand, the War left Europe with a labor surplus in many countries, because decreased emigration and the natural increase of population more than offset, except in France and Russia, the war losses; while, since the War, national policies have restricted the redistribution of excess populations. It bequeathed an excess producing capacity in iron and steel, chemicals, and certain other products which were essential for war operations. Huge war construction, together with miscalculations after the War, created a huge surplus of merchant shipping. Such surpluses must be built down, transformed, or absorbed before economic equilibrium is possible.

These maladjustments have been magnified since the War by territorial changes involving huge shifts of natural resources and the partial divorce of coke and iron, by the redistribution of wealth and the impoverishment of the old *rentier* and middle classes in several countries in consequence of currency debasement, and by the profound retrogression of Russia. Consumption demands

and channels of trade have been radically altered. Natural markets have been disorganized or destroyed. The economic world cannot adapt its fixed capital or its operating processes to such far-reaching changes without friction and delay. Moreover, with the supply of entrepreneur ability diminished, the post-War problems complicated by currency chaos have multiplied the difficulties to be coped with in domestic and international trade.

These problems have been further magnified by colossal bungling of the peace arrangements, not merely in its paper terms, but even more in their execution. However the responsibility be apportioned, it cannot be gainsaid that Europe's economic progress has been greatly retarded by the confiscation of German tonnage, the effort to collect impossible reparations, the inability to compromise international indebtedness, the recurrent deadlocks among the nations concerned in the settlement, and the affair of the Ruhr.

In view of these grave derangements, it is not surprising that all the industrial and commercial nations of Europe, one after another, have been overtaken by severe business crises and have found it difficult to emerge from the subsequent depressions. The earliest sufferers were countries with sounder financial structures and saner fiscal and financial policies. With the help of inflation some countries put off the evil day, but it has finally dawned for all. The position of Germany, the latest to succumb, must be interpreted as the joint result of an overdue trade crisis, postponed but intensified by prolonged currency debasement and now precipitated by attempts at currency and fiscal stabilization, and of the disastrous effects of the Ruhr occupation, and the ill-conceived "passive resistance" with which it was met.

These cyclical movements must be distinguished from underlying trends, if we are to understand the course of developments in Europe.

Some Necessary Assumptions

Upon a few points which are vital to the consideration of the European outlook, an economist can venture no prediction. But these matters cannot be ignored. It is therefore necessary to proceed upon certain assumptions which may or may not be valid, but whose validity is independent of the subsequent reasoning. Accordingly I assume, without arguing the reasonableness of the assumptions or implying that their soundness can be proved:

(1) that European progress will not, in the near future, be seriously disturbed by a general war or by important lesser military operations;

(2) that Germany will not, in the near future, disintegrate politically or suffer irreparable economic collapse;

(3) that no comprehensive, definitive settlement of the reparation issue will soon be reached, but that progress will be made in coping with reparation problems;[1]

(4) that the United States and Great Britain will not press France and Italy in the near future for interest or principal of their debts, and that with this forbearance France and Italy can carry on without considerable reparation payments;

(5) that the gold standard and currency stability will not soon become universal in Europe, but that seri-

[1] The Committees of Experts appointed by the Reparation Commission, shortly before this paper was read, succeeded in making a much larger contribution to the solution of the reparation problem than my assumption implied, but their proposals are properly regarded as a working basis for settlement rather than as furnishing the settlement itself.

ous outbreaks of fresh currency inflation, where it has been checked, will not occur;

(6) that American official policy, with respect to international indebtedness or coöperation in Europe, will not be reversed, and that no huge extension of credit to Europe will be made.

Furthermore, I assume that ascertainable trends and tendencies will continue without abrupt and general change, though modified by numerous factors which can be anticipated only in part.

Those who object to these premises may well differ from my conclusions; and, if time falsifies the assumptions, it will probably also show the conclusions in some measure unsound. I wish to dissociate, however, any dispute over the assumptions, which are admittedly debatable, from the reasoning which proceeds in part upon them. With this view of the background and these assumptions concerning the future, we may sketch the main features of the present position and outlook for which statistical and other evidence affords some reasonable basis.

The Outlook by Countries

Germany, after three years of progress in agriculture, industry, and commerce, amid fiscal and currency deterioration, has suffered a serious general setback since the middle of 1922, which is traceable to the culmination of currency disorder, attempts at currency and fiscal sanification, and the economic war in the Ruhr. It is an economic crisis, with numerous and peculiar complications. The depression is now apparently near its worst. Economically, as well as politically and socially, Germany's position is unstable and her outlook uncertain. Unfavorable factors are the lack of any general settlement upon

reparations, internal conflict between labor and capital, the ruin of the middle class, and difficulties in establishing a sound currency. Favorable factors are the possession of large natural resources and elaborate physical capital in fairly good order, the proved resourcefulness of the German people under strain, the fair crops of 1923, and the recent conclusion of working agreements with France with respect to deliveries in kind. The recent retrogression has been undeniably serious, but it cannot be compared with the Russian *débâcle*. Already Germany is assured of a larger food supply than in the crop year 1922–23, though its effective utilization is temporarily restricted by currency repudiation. The immediate future bristles with difficulties, political, financial, and industrial, but if a political breakdown can be averted, it is not unreasonable to expect a gradual resumption of productivity in the Ruhr and a slow approach toward equilibrium in German economic life.

Russia reached the nadir of retrogression in 1921, in profound economic collapse. Since then, aided by successive modifications in Soviet policy and two favorable crop seasons, significant improvement has been registered in agriculture and transport, and in lesser degree in industry and trade. Even to make this progress secure, much more to continue the rehabilitation, Russia needs foreign capital, entrepreneurs, and technical skill, for which the established Government is indisposed to pay the price. Yet, through moderate exports of Russian agricultural products, and through pressure of foreign producers well armed with credit, the slow revival in Russia bids fair to proceed, though haltingly, unless arrested by serious crop failure.

Belgium and France have made great strides in repairing War devastation and show upward trends in agricul-

ture, industry, and trade. They recovered quickly from industrial reaction in 1921–22 and successfully coped with the difficulties imposed by the Ruhr affair in 1923. Fiscal problems remain largely unsolved; their currencies lack stability; and their price levels have increased disquietingly. Yet while the French Government is going deeper into debt every year, the French people, with little outside help, are paying for reconstruction and providing some new capital out of current production. In the same sense Belgium, too, appears to be paying her way as a nation. Both in France and Belgium, the checking or reversal of franc depreciation will adversely affect exports and business activity dependent upon exports, but only a marked improvement of the franc would prove serious. The reconstruction work itself is a steadying influence. Eventually, grappling with fiscal problems may react seriously upon business, but no immediate action is in prospect and meanwhile taxable resources are increasing. Continuation of present economic progress, at a slackening rate of improvement and with occasional interruptions, is in prospect.

Elsewhere in Europe where trade depression exists (save in Poland), 1923 generally showed some recovery, in part indeed because of reduced uneconomic competition from Germany and increased demands for coal, iron and steel, and shipping incident to the closing of the Ruhr. Revival of German production will react unfavorably upon these industries, but favorably upon most others. In Holland, whose trade has been influenced unfavorably by decadence in Germany, and in Czechoslovakia, where the industrial depression arrived late, recent gains have been moderate; but in Italy, Switzerland, and Sweden, the progress has been marked. In most of these countries the financial situation is reasonably

sound, and prices and exchange are comparatively stable, but unemployment is abnormally large. Further recovery in industry and trade, rather than fresh severe reaction, is in prospect, but in most countries its completion is distant.

In agricultural countries like Poland, Italy, Hungary, and the Balkan States, a clear improvement in agriculture and good crops in 1923 are vital favorable factors, as indeed they are in several other countries. Except in Poland, instability of currencies and prices has been reduced; and generally in these countries only a determined effort would be necessary to achieve balanced budgets and stable currencies. Italy and Yugoslavia have gone far along this road, but in the other countries there is no assurance that the requisite effort will soon be made. Finland has achieved substantial equilibrium, both fiscally and commercially; and the other Baltic states have gone far upon the same road. Here and in Poland, the restriction of the Russian market and disorganization of Germany hinder general progress, although some industries are stimulated thereby.

Austria is being regenerated under receivership. Similar aid to Hungary, now almost at hand, should promote like progress there. Turkey and Greece are painfully liquidating the peace in the Levant and adapting themselves with difficulty to a vast displacement of population, as well as coping with complicated political problems.

The Outlook by Phases of Economic Activity

Agriculture, Europe's basic industry, has notably revived. An upward trend is visible in the statistics of acreage and yield of leading crops in almost every country. While this cannot continue indefinitely at present

rates, no reversal is in prospect. Weather conditions, which reduced grain crops in 1922 and brought good crops in 1923, will of course continue to affect the yearly out-turn. Europe's live-stock herds, though far from completely restored, especially in Russia, Germany, and Eastern Europe, have increased considerably. Europe's peasantry, on the whole, is fairly well off outside of Russia, and relatively comfortable even there.

The coal position is not serious. Though prices are generally high, no shortage exists outside of Germany and its immediate coal markets. British and Dutch outputs exceed pre-War levels. Belgian production is practically normal. With the gradual restoration of the devastated mines in Northern France, French output is steadily rising toward the pre-War average. Production in the Saar, which suffered through labor difficulties in the first half of 1923, is running on a level not far below pre-War. The German lignite output has been greatly increased. The division of Upper Silesian coal fields only temporarily reduced their output materially. With the ending of the Ruhr conflict, the Ruhr mines may be expected gradually to reach and eventually exceed their previous output. As this is accomplished, the moderate shortage in France and Luxemburg and the more serious shortage in Germany will be relieved, coal prices will further decline, and the abnormal shipments of coal from Great Britain to the Continent will fall. Unless this is accompanied by unexpected improvement in other foreign demand, the British output may somewhat decline, though conceivably improved domestic consumption may offset some decline in exports.

From the slump in 1921, iron and steel production has materially increased, outside of Germany. For France, Belgium, Luxemburg, and probably Germany as well,

1922 showed the best output since the War. In 1923, British and Belgian outputs were even larger. The Ruhr entanglement reacted severely on French and Luxemburg production for a time; but their recent outputs have approached previous post-War maxima. Italian, Austrian, and Czechoslovakian outputs improved in 1923. The German production, on the other hand, was greatly curtailed. Now, however, German and French industrialists appear to be coming to terms upon measures for coördinating their coal, iron, and steel interests — a move essential to Europe's peace and productivity; but this end is not yet achieved. The iron and steel outlook is not clear. A struggle for markets is in prospect, in which the British, whose exports have lately exceeded pre-War levels, will face particularly severe competition. Capacity operation of Europe's iron and steel equipment will be possible only as capital resources become available for vast reconstruction in Russia and Southeastern Europe and in capital improvements elsewhere, which cannot be expected in the near future; but the competition will favor construction work and essential extensions of credit.

Shipbuilding is exceptionally depressed. Few new keels are being laid, and tonnage under construction has fallen to very low levels. This is due partly to suspensions of naval construction, but more to a plethora of merchant shipping resulting from huge War construction, the ill-advised shipbuilding boom in 1919–20, and rapid German construction favored by abnormally low costs.

The recent decline has been intensified by labor troubles in Great Britain. Because of deterioration of idle shipping and the failure of new launchings to make good the depreciation of fleets, the present surplus is less in reality than in appearance. The depression may be near

its worst, but at best the revival will be slow and it can hardly be considerable in 1924.

The direct devastation of the War has been largely made good in respect of productive equipment. The coal mines of Northern France are the conspicuous exception; but even these, late in 1923, were producing some sixty-five per cent of their pre-War output, as compared with three per cent in 1919, and thirteen per cent in 1920. The deterioration of neglected capital equipment, notably of railways, housing facilities, and consumers' capital generally, has been far less completely made good, and in some areas is continuing; but even in Russia and Eastern Europe new railway equipment has been obtained and at least the main lines improved, so that ability to export is less seriously hampered by transportation difficulties. Cultural resources, notably in Russia and in some degree elsewhere, have been depleted. In general, however, Europe's immaterial capital is being steadily restored. In reconstructing the network of business relations across national boundaries, significant progress has been made. Incomplete though these processes are, it is undeniable that since 1919 or 1920 noteworthy gains have been made which will not easily be lost. Even amidst the Ruhr campaign, mines and plants in this area were renovated and improved; and the economic warfare merely interrupted or modified temporarily, and did not break, the connections between German and foreign business. In these respects even in Russia, where the deterioration was extremest and the breaking of business connections most thoroughgoing, evidences of revival are numerous. Such gains, for the most part, are not statistically measurable, and show their effect upon statistics only after considerable lag; but they are no less important.

Shipping is active. Arrivals and departures have im-

proved steadily. In 1923, in several leading maritime countries, they exceeded those of 1913. This reflects a large and increasing volume of international trade, of which increased export tonnage figures give further evidence. The comparison with 1913, however, is not as favorable as it seems, since part of the recent increase is attributable to dislocation of production, notably in cereals, fuel, iron ore, and pig-iron. Despite this shipping activity, there is considerable idle tonnage in Europe, though less than in the United States. A good deal is obsolete, and a good deal will not warrant reconditioning. The abundance of shipping is reflected in low shipping rates, which are generally not far from pre-War levels, so that shipping is commonly unprofitable at present levels of costs. The revival of Ruhr coal production and decreases in Europe's cereal imports will tend directly to reduce the demand for shipping, though indirectly their influence may be favorable. There is no early promise of a pronounced rise in shipping rates, but a further material decline is also unlikely. It is important to recall that (except in Norway) ocean shipping is largely owned in countries which can best afford the loss of income incident to low freight rates, and that the rest of Europe is favored by these low rates.

Railway transport is disorganized in Germany, but not fundamentally injured. In Russia and Eastern Europe generally, it requires much further improvement in facilities and equipment. In Western Europe, normal railway conditions generally prevail, though financial equilibrium is not generally attained. International obstacles to through traffic, though still considerable, have diminished.

International trade has been somewhat dislocated by the Ruhr disturbance, but upon the whole, outside of

Germany, has increased in amount and improved in balance, facilitated by internal readjustments and by numerous commercial agreements. Nevertheless, surpluses of labor, capital, and producing capacity in certain areas coexist with serious deficiencies in producers' and consumers' goods in other areas. The flow of labor, capital, and goods is restricted by lack of confidence, credit, and buying power in deficiency areas, as well as by tariffs and other boundary restrictions. Needs are not translated into effective demands. There is no ground for expecting any rapid or complete transformation of this situation. But little by little, the worst obstacles are breaking down, mainly through private initiative but partly through international conferences and agreements. It is to the continuation of this process rather than to flotations of huge international loans or other gigantic extensions of credit that we may look for the gradual readjustment of markets and resources.

The process of saving is still hindered, both by unemployment and the generally small margin of incomes over living costs, and by the continuing depreciation of currencies in a few countries. In both respects some gains have been made. Only in Great Britain, Holland, and Switzerland is there a material surplus for foreign investment. Appropriately, therefore, in these countries, money rates are low; elsewhere, in varying degrees, relatively high; but the high rates, where they are not largely insurance premiums against currency depreciation, reflect the capital position rather than monetary tension that might signalize the approach or existence of financial crisis.

Conclusion

Upon the whole, Europe has gone forward rather than backward in recent years, though the progress has been

irregular and disappointing and instances of retrogression have been numerous. In 1923, economic progress was general except in Germany. Europe is on the up-grade, not the down, but the pull is hard and long. The present crisis in Germany, though intensified by the Ruhr struggle, has long been inevitable as a transition to a sound economy. Europe's economic structure has proved resilient under the strains of peace, as under the shock and strain of war. The results have repeatedly confounded prophets of desperation, as well as cheerful optimists. Statistical evidence lends small support to assertions of complete chaos or forecasts of general collapse, or to expectations of early complete recovery. In the main, destructive factors have done their worst for the present; and constructive ones slightly predominate.

CHAPTER XXI

AN EXAMPLE OF BUSINESS FORECASTING [1]

By CHARLES O. HARDY

THE year 1923 was a good year for business, but a bad year for business forecasters. The year came in with business on the up-grade, and with forecasters in general agreement that the outlook was bright for continued and increasing prosperity. For four years the course of business, as measured by the familiar indexes and forecasting devices, had been following the precedents which had been observed in the cycle of prosperity and depression in the years before the War. Predictions based on these precedents were achieving a degree of success, which was rapidly bringing about an agreement concerning the main outlines of a technique of forecasting business conditions. There was even being engendered a certain degree of public confidence in the value of such forecasts.

For the first four months of 1923, this harmony between the anticipated and the actual course of business continued; but since that time the prestige of the prophetic fraternity has somewhat declined. The up-swing of business which was generally forecast at the beginning of 1922, and was recognized to be in progress at the beginning of 1923, terminated unexpectedly in April; and in its termination failed to observe the generally accepted rules of conduct of decent and orderly business cycles. For example, the industrial stock market, instead of preced-

[1] A forecast for the immediate future is soon out-of-date. This particular forecast, however, is such an admirable illustration of method that it appears to have permanent value for students of the problems of business forecasting. — *The Editors.*

ing the movement of prices and general business by from two to ten months, made its peak in March, in the same month with most of the so-called thermometers of business activity, while the money market, instead of lagging from two to eight months behind general business, turned downward in April. Moreover, though interest rates had been advancing for nine months, there were lacking the familiarly anticipated phenomena of tight money preceding, and frozen credit following, the peak of activity. Still another factor, different from what we had come to regard as typical, was the temper of the business community. As it became clear that the tide of business was rising in the fall of 1922 and especially in the spring of 1923, we should have expected, according to the best remembered precedents, that there would be generated a spirit of over-optimism, expressing itself in excessive purchases both for stock and for speculation, with resultant boosting of prices — the purchases stimulating the price rise, and the rise stimulating more buying. In 1923, however, the reverse situation obtained. Instead of generating a burst of enthusiasm, the business expansion aroused a spirit of caution; rising prices checked buying, rising wages checked construction, and, instead of a swift rise and a precipitous drop, the cycle culminated in a mild swell followed by a gradual decline.

Because of these peculiarities in the 1923 peak of business activity, the best known mechanical forecasters failed to predict the decline until it was well under way; and those business prophets who placed their reliance in them have been reluctant to admit the genuine character of the down-swing of the cycle which followed. There seems, however, to be no good reason for excluding the movement of the last eight months of 1923 from the category of general business declines. Our task in examin-

ing the outlook for 1924 is to decide whether we have reached the bottom of this down-swing, and if not, what is its probable further duration. This involves first an examination of the usual statistical barometers which would determine our position in the cycle if it were wholly typical; and second, economic analysis to determine how far the typical situation is modified by exceptional circumstances.

In checking up the statistical evidence of the state of our business health, the most favorable indications are found in the figures for building activity, railway car loadings, and the banking situation. The least favorable indications are shown by the general indexes of production, the specific figures for production of iron, steel, and basic raw materials, the record of exports, and the reports of inventories. Intermediate between these two groups, we have others in which the situation is so balanced that it is impossible to draw any definite conclusion from them. This group includes the security markets and general wholesale prices.

Let us consider first the group of indexes which we have classified as favorable. Building constituted the backbone of the revival of business activity in 1922 and 1923, and the indications are that the nation's building program will continue to absorb an abnormally large proportion of our labor and capital.[1]

A second business index which, at first sight, tends to give us an optimistic view is the record of car loadings. In absolute figures, all records were broken week after week, the total for the year 1923 to December 1st being ten per cent above the previous high record made in 1920.[2] Car loadings constitute, in my judgment, the most dependable single indicator of the activity of business; and, the main-

[1] See Chapter X, above. [2] See Chapter V, above.

tenance of loadings at such a high level, continuously through the year, is undeniable evidence of a prosperous state of business in general. The significance of these figures is lessened, however, when we make allowance for secular trend. Railway tonnage has been increasing for many years at an average rate of about six per cent a year, and this rate means that an average year shows tonnage about sixteen per cent above the average level of the preceding four years.

An examination of the figures as classified by commodities, makes the showing still less satisfactory. The best record has been made by lumber, which has been shipped throughout the year in a volume around thirty per cent above the four-year average. Only once has the figure dropped below 120, and five times it has gone above 140. This, of course, is to be accounted for by the high level of building activity to which reference has already been made. The other principal factor in the high level of railroad activity during November was the shipment of grain, which has shown much more than the usual autumn increase, in compensation for an abnormally slack movement during the early summer. Manufactured products have been shipped in volume ranging from 10 to 20 per cent above corresponding weeks in preceding years, while coal and coke figures have been making relatively the poorest showing for the last three months. This, in part, is to be accounted for by mild weather, but it also reflects the slackening of industrial activity. Finally, the figures for banking reserves, rediscounts, and interest rates, while they do bear evidence of slackening business during the past few months, are extremely favorable in that they indicate an abundant reserve supply of credit which would enable us to finance a greatly increased volume of business without the creation of a tight money

market. So much for the bright side of the picture. The facts so far cited indicate that we are in a prosperous condition, though prosperity is at best not increasing.

Let us turn now to the business indexes which seem to give ground for pessimism. The general production index of the Federal Reserve Board,[1] which reached a high point of 128 in May, 1923, declined to 114 in September, and rallied to 117 in October. The Harvard index of production shows a similar decline. Pig-iron production declined from a daily average of 124,764 tons in May to 96,476 in October; steel-ingot production was lower in November than it had been for fourteen months. Woolen-mill activity, coal-mining, sugar-melting, paper production, and cotton consumption all show similar, though in some cases less pronounced, downward trends. The unfilled orders of the United States Steel Corporation showed a decline in every month since March, and in December stood at the lowest figure since February, 1922.

Another unfavorable index of business activity is that furnished by the statistics of goods on hand. Department store stocks as reported to the Federal Reserve Board are now at a higher level than at any time since the close of 1920, and have increased over last year much more than has the volume of sales. Stocks reported to the Federal Reserve Bank of Chicago by manufacturers, wholesalers and retailers nearly all reflect this same tendency toward a piling-up of goods. For example, stove and furnace manufacturers' inventories were reported in October as thirty-eight per cent above the figure for October, 1922; leather manufactures, thirty-seven per cent above. Cement stocks are reported by Bradstreet's as thirty per cent higher on November 30 than a year before. Wholesalers in the Chicago district reported stocks heavier in all

[1] See Chapter III, above.

commodities except shoes and drugs. Fall sales are generally reported as slow. Woolen manufacturers, for example, report hand to mouth buying. Furniture manufacturers report to the Federal Reserve Bank of New York orders thirty-six per cent less than a year ago. Building activity has been encouraged by the mild weather, yet many brick plants are closed in the Chicago Federal Reserve district and lumber is reported to be selling below quoted prices. The automobile industry, which displayed enormous activity during the first six or eight months of the year, has lapsed into more than seasonal dullness, at least in the West.[1]

Most unfavorable of all are the indications given by the records of our export trade. For the first nine months of 1923 the physical volume of exports was below the 1922 level by ten per cent; 1922, was below 1921; and 1921, below 1920. There is no indication of a reversal in this downward trend. It is true that exports for October and November showed a considerable increase, but this was due entirely to a somewhat more than seasonal expansion of cotton shipments.

The price indexes give no clear view of the situation, as the changes over the past six months have not been great, at least in comparison with the changes to which we have grown accustomed, and the different indexes have often given contradictory reports. On the whole, however, the price movements have been in harmony with the group of barometers which I have classified as unfavorable.

The stock market turned sharply upward on November 1st, after a prolonged decline. Stock prices are probably our most popular barometer, and the strong market of November was generally hailed as a prophecy of business revival. It is too early to base any prediction on this

[1] See Chapter IX, above.

evidence, however, for a reason which is inherent in the use of stock prices for forecasting purposes. Stock prices do show a remarkably uniform record of advances and declines in advance of the major changes in commodity prices and business activity, but in every major stock market movement, up or down, there are innumerable reactions against the main trend — reactions lasting anywhere from one hour to two months — and it therefore is impossible to identify the turning points till we are well past them. Stock market commentators have generally expressed the opinion that the market hit bottom before the November advance, but there is really little ground for this opinion; it is rather a case of the wish fathering the thought.

In this connection attention may be given briefly to the question whether the stock market really failed to forecast the present business decline. According to the indexes generally used, stock prices made a peak simultaneously with general business last spring instead of from two to ten months earlier. This, however, is a less pronounced discrepancy than it appears, for it is largely a matter of the choice of the index of stock prices. It affords an illustration of the difficulty in using stock prices as a barometer. Security markets made a high point in the fall of 1922, declined for several months, and then rallied in the spring of 1923. In this rally industrial stocks went four or five points higher than in the fall, but railroad stock prices fell short of the autumn peak, and bond prices hardly rallied at all. Whether the peak came in the fall or the spring, it is therefore hard to say. The tradition has been established that industrial stock prices are a better barometer than railroad stock prices or bonds. In my judgment there is little statistical basis for this opinion, but even if it is true it will hardly be con-

tended that the difference between the high point of 104.3 in the fall and that of 100.4 in the spring[1] is big enough to be significant.

So much for the popular barometers. Whatever our individual differences of opinion may be as to the relative value of these indicators, there is little disagreement as to the main outlines of a classification of business variables in accordance with their usual cyclical sequence. The tendency is clear for stock speculation to move first, both in the up-swing and in the down-swing of prosperity. Various measures of general business activity, such as outside bank debits, prices, production, car loadings, make up a second group, and the third, the lagging group, consists of interest rates, reserve ratios, and other measures of credit ease or strain.

Disregarding the exceptional aspects of the present situation and fitting the data into this scheme as well as we can, the most reasonable conclusion is that we are in the midst of a period of mild liquidation. Business is still above normal in activity; but there are numerous exceptions, and the trend is downward. The stock and bond markets have either already made their low points for the present movement or will do so within two months; general business activity and wholesale prices will continue to decline through the spring, and interest rates will display weakness for nine months or a year. Such a development would be fairly well in line with pre-War precedents.

Before accepting this as the best forecast we can make, however, it is necessary to apply the method of economic analysis to the data which indicate that the present cycle is exceptional. In doing so we may consider three items: the credit situation, foreign trade and foreign politics,

[1] Harvard average of twenty industrials.

and the spotted character of last spring's boom. First, let us consider credit. There has been in 1923, as we have noted, a discrepancy between the actual and the anticipated relationship of interest rates and the volume of production. Last spring there was no real tight money at the peak of industrial activity, and the decline began in April. Several forecasting services, including Harvard and Brookmire's, have attached very great importance to this phenomenon. The emphasis is quite in line with the importance attached by many present-day students of the cycle to credit conditions as a cause of prosperity and depression. Hansen, for example, says: "The movement of reserves, loans, deposits and money rates is *the* causal factor working out its influence on stock and bond prices, transactions on the stock exchange, bank clearings, business failures, building, employment, production, imports and exports, prices and profits." Numerous other leading students could be quoted to the same effect. With this view I find myself in disagreement, at least so far as short-term interest rates are concerned. Rising interest rates are a laggard consequence of increasing activity of business; but interest rates are by no means a necessary factor in bringing about a rhythmical alternation of increasing and decreasing activity. The cycle is primarily a phenomenon of production, of alternate production of goods in excess of the current rate of consumption, with consequent accumulation of stocks, and curtailment of production below current consumption, with consequent depletion of stocks. Only in far lesser degree and only as a by-product of curtailed employment and lower profits, is consumption affected; the bulk of the adjustment is made in the rate of saving and not in the rate of consumption. The consumption cycle is never an independent cause, but only a result. Changes in short-term interest

rates are also a result but do sometimes become effective causes — causes, however, of a negative type. Tight money sets limits to a boom; easy money does not of itself cause a boom. The activity which characterizes a boom period may be checked in any one of several ways. If it is not checked sooner in some other way, it proceeds to the point where it is checked by money conditions. This was apparently the case in 1907 and 1920.

It does not necessarily proceed to this point, however. It is essentially a speculative phenomenon, and there is never any way of predicting, except negatively, how far a speculative boom will run. A boom ends when those who believe it has gone too far become numerous enough to outweigh those who think it will go farther. This belief may be forced on men by their sheer inability to obtain funds to finance a further expansion, but this belief may arise long before that point is reached. In 1895, in 1909, and in 1913 the upswing of business apparently did not proceed to the point where liquidation was forced by money conditions. Shall we, therefore, deny to these movements the character of true cyclical peaks? In 1923 the same thing happened in a more pronounced way. The memory of 1920 was fresh in men's minds, and the rise of prices and the expansion of production soon caused a development of caution and a slackening of business activity. More complete statistical information and better knowledge of the cycle than the business world has had in the past, may have contributed to bring about this result, but the principal cause was the fact that men had not forgotten the experiences of 1920. This situation is not unique; it is similar to the culmination of prosperity without a forced check from money conditions which occurred in 1895 and in 1909, when men were still awake to the impressions of 1893 and 1907.

The third peculiarity of the prosperity movement of 1923 is its spotted character. Manufactures of iron and steel ran above normal [1] for ten months, but copper production has reached a normal figure only since July, and at no time for several years has there been a satisfactory market in which to sell the reduced output. Automobiles were produced and sold in the first eight months of 1923 in almost incredible numbers, but the agricultural implement business was very dull. Chemicals, leather and shoes, textiles, and rubber had a bad year. Tobacco, most foods, and retail trade generally did very well.

The key to an understanding of most of these discrepancies is found in the condition of the export market. Through rising prosperity and declining prosperity alike, the volume of exports declined. The decay of our export trade, resultant from European economic disorganization, materialized later than many economists expected. The year 1923 did, indeed, show that we are not as highly dependent on foreign trade as many of us had supposed. It showed that, without satisfactory export conditions, we can raise the real wages of our industrial laboring population to the highest figure in history, increase our equipment of houses, consume more food and clothing than ever before, and increase our capital equipment at the same time. The record of the year in this respect is impressive; but 1923 also showed that, as we are now organized, we cannot have a balanced prosperity without better export markets. The line between prosperous and depressed industries in 1923 corresponds very closely to the line between those which are and those which are not highly dependent on foreign markets. Railway equipment, automobiles, tobacco, sugar, house building, paving and highway building are the lines in which the

[1] As computed by the Federal Reserve Bank of New York.

domestic market counts for the most and the export market for the least, and these lines have enjoyed the flush period of a business cycle. From them the stimulating influence has radiated into the manufacture of iron and steel, coal, cement, lumber, and brick; and their activity, together with good crops, has in turn produced a large volume of business for the railways. The downswing of business over the last six months has been a normal reaction from the excessive activity which these lines of business induced in one another, and indicates no more than a cyclical weakness.

On the other hand, ocean shipping, copper production and agriculture, especially rye, wheat, and hog and cattle production, contended with low prices and slack demand. Cotton, save for the effect of disastrously low crops in recent years, would probably be equally depressed. From these lines the depressing influence radiated to fertilizers, agricultural implements and the mail order business. In these latter lines, however, the declining tendency of the last six months has been least evident. There was no boom and there was no reaction, and during the last two or three months there has been some slight evidence of improvement. The value of farm products is greater than in 1922, and the results are appearing. It does not appear, however, that the causes of the weak position have been removed.

This contrast gives us the clue to our final estimate of the business outlook. The *immediate* outlook is for a continuation of the movement which has been going on during the summer and fall, that is, a further decline in the enterprises which enjoyed high prosperity last spring, and a recovery in agriculture and its ancillary lines. The improvement which has shown itself all fall in mail order sales is beginning to show in agricultural implements, and

seems likely to spread into the fertilizer trade, and to help the Northwestern railroads which have been so hard hit by the agricultural depression. All kinds of business which depend for their prosperity on agriculture should do somewhat better in the spring of 1924 than they did in the spring of 1923. On the other hand, the more numerous industries which enjoyed high prosperity in the first part of 1923 seem likely to take another six months or so to complete their cyclical down-swing. Car loadings will probably decline, unemployment will increase, and prices will decline.

But this is a short-run view. There is no prospect of an early reversal of the forces which have made for depression in lines of business dependent on the export trade, and for prosperity in those which cater to the domestic demand. That the real wages of industrial labor are higher and the real income of farmers lower than in 1914 is due to the War. The readjustment of our productive forces has not been completed, nor can it be completed until the future of Western European civilization becomes more settled. By the autumn of 1924 the reaction from the mild boom of 1923 should have spent itself. Surplus stocks should be worked off and business in general resume its upward trend; and once more, as in the spring of 1923, the conspicuous laggards should be the businesses whose prosperity depends on the buying power of Europe. To some extent the discrepancy may be lessened in the meantime by redistribution of our own productive efforts, but the chances are at least even that any gain from this source will be more than offset by a further decline in exports. This forecast may, of course, be upset by an unexpected turn of events in Europe, but this does not seem likely, so far as 1924 is concerned. What our prosperity will be five years from now depends

largely on what happens next year on the Ruhr and on the Rhine, but nothing that is likely to happen there will make a great difference in the *immediate* business future.

The outbreak of a serious war in Europe would at first tend to help American business. Sales of our agricultural products would increase, financed by the sale in this country of large new issues of European securities at exorbitant rates of interest. The prices of exported goods would rise, and the resulting stimulus to business would mean both increased employment to industrial labor and increased profits for manufacturers. As compared with the situation in 1915, however, the rise would be less extensive; and, even more than in the earlier case, the tendency would be for the rising cost of living to eat up the gains from our enlarged market. This would necessarily be true, for the reason that the increased purchases of Europe would have to be financed much more exclusively on credit than was the case in the early years of the War.

On the other hand, a peaceful and satisfactory settlement of the Ruhr dispute, which included a stabilization of German and French currency and a revival of productive activity in Europe, would stimulate both our imports and our exports, and would bring more lasting benefits. Such a settlement would make enlarged markets for our products, and the imports received in return would prevent the gain from being eaten up by an advance in the cost of living. A development of this kind, which it must be admitted seems rather improbable, would mean a permanent gain for farmers, copper producers, railways, and the manufacturers of specialties which do not feel European competition, but on the other hand would create new difficulties for manufacturers who have to meet European competition, either here or in foreign markets. Finally, what now appears most prob-

able, namely, an indefinite prolongation of the present uncertainty and distress in Europe, does not give promise of causing any marked change in our business situation during the next six or twelve months. European politics carry with them the seeds of American prosperity and depression but the seeds will not germinate, grow and bear fruit in a single season.

In conclusion, one of the most hopeful aspects of our domestic situation is the attitude revealed by the course of events in 1923. The forces which make for a cyclical movement in business are inherent in a competitive form of organization. So long as this form of organization persists there is hope of reducing the violence of cyclical changes but hardly of eliminating them. If the business world learns to interpret an excess of production over consumption as a signal for caution and not for increased haste in buying, the evil results of the cycle will largely disappear. In the next and in succeeding upward swings, the memory of 1920 will be less vivid than it was in 1923; it is our responsibility as students of the business cycle to keep that experience from being forgotten, and to contribute what we can to a better understanding of the perils of the easy assumption that increasing orders and rising prices are a signal to expand inventories and plants. To the extent that we succeed in doing this we increase the probability that each future upward swing will culminate, as has the last, in a mild swell and a gradual decline.

THE END

INDEX